

Ken and



SCOPE



LETTERS

Sir:

With the co-operation of the Buffalo Museum of Natural Science, the Amateur Telescope Makers and Observers of Buffalo entertained more than 1,000 cub scouts on February 1st. Astronomical movies were shown continuously from 3:00 to 9:00 p.m. Small groups were guided from there to the hall of astronomy, the Spitz planetarium, an exhibit of telescopes and astronomical teaching aids, and the Kellogg Observatory.

The cubs were asked to observe and report the lunar eclipse of February 10th. There were early returns from 39 youngsters. Drawings indicate good observation of the shape of the shadow at mid-eclipse.

F. SHIRLEY JONES
Buffalo Museum of Science
Buffalo 11, N. Y.

Sir:

For most persons just beginning their study of astronomy, as well as for many like the writer who can follow it only intermittently, it is very easy to forget one rather important pattern of the solar system—the radial order of the planets. Bode's law provides us with a handy means for quickly estimating the planetary distances, but if the order of the planets slips our minds we are little better off than if we didn't know Bode's law either.

To those, then, who forget but wish they didn't, the writer offers a suggestion. The initial letters of the planets fall in the order of the initial letters of the words of the following mnemonic sentence (perfected only after many long minutes of effort):

"Solar Mass Very Easily Makes All Jupiter's Satellites Undergo Numerous Perturbations." The initial word puts the sun in its proper location (for those who are really forgetful); and "All," like Bode's law, takes account of the asteroids.

If anyone should object that solar gravitational influences really aren't terribly significant in the orbits of any but the outermost of the Jovian satellites, the writer must agree, but points out that this sentence does at least convey incidental information of greater value than that in the more famous mnemonic for the stellar spectral classes.

JAMES E. McDONALD
Iowa State College
Ames, Iowa

Sir:

I recently purchased a copy of *Sky and Telescope* from a newsstand, and immediately became one of the family. I am an amateur astronomer as well as a gospel minister. As I leave church in the evening, I note the position of the stars, and I check with my watch.

Here on the California coast we seldom see many stars at night, because the air is misty. However, I can usually see the Big Dipper and the Little Dipper, and I find it interesting to note their position and check the time. One evening I found that my watch had stopped, and as I was used to checking the position of the dippers, I estimated the time and set my watch by the stars. The next day I found that it was only five minutes behind

Sky and TELESCOPE

Copyright, 1952, by
SKY PUBLISHING CORPORATION

CHARLES A. FEDERER, JR., *Editor*; HELEN S. FEDERER, *Managing Editor*
EDITORIAL ADVISORY BOARD: *Clement S. Brainin*, Amateur Astronomers Association, New York; *Edward A. Halbach*, Milwaukee Astronomical Society; *Donald H. Menzel*, Harvard College Observatory; *Paul W. Merrill*, Mount Wilson Observatory; *Charles H. Smiley*, Ladd Observatory; *Percy W. Witherell*, Bond Astronomical Club.

time! Perhaps this little incident will encourage other amateur astronomers to become aware of the great clock of the sky.

REV. DELBERT BULLIS
213 Cottage Grove Ave.
Santa Barbara, Calif.

Sir:

On Saturday, March 1st, the atmosphere was quite clear in Syracuse, N. Y., when I went out before sunset looking for a good vantage point from which to view Mercury (found in 6 x 30 binoculars quite easily, but just beyond the range of the average unaided eye).

To my initial disappointment, the sun entered a heavy cloud bank about one degree above the horizon in an otherwise clear sky. As the last remnants of the sun disappeared into the cloud, the green flash came into view and caught me quite by surprise. I was watching the solar limb in the binoculars. The air was transparent enough to have required a filter to look at the sun before it contacted the

cloud, but during the last half minute before the upper limb vanished, the sun could be comfortably viewed without a filter.

The mountain peak effect of the cloud permitted two views of the flash not more than two seconds apart. The color seemed definitely bluish, perhaps partly real and partly retinal fatigue in the red.

I do not recall any references to the green flash in the literature describing observation of it behind a cloud bank; the emphasis is always on a distant horizon preferably over water. My only view before this was over Lake Ontario last summer. Perhaps, with the aid of a cloud bank or a very distant hill, optimum visibility might be procured by balancing the greater dispersion at low altitude against the greater transparency at higher altitude.

PAUL W. STEVENS
2322 Westfall Rd.
Rochester 18, N. Y.

VOL. XI, No. 7 WHOLE NUMBER 127

CONTENTS

MAY, 1952

COVER: On this portion of a photograph taken with the 20-inch astrographic telescope of Lick Observatory, five asteroids have left their trails during the two-hour exposure; they are indicated by the arrows. The plate was taken through a coarse grating over the telescope objective to produce short spectra for photometric purposes. North is at the top, east at the left; the center of the field is approximately at $12^{\circ} 3^m.5$, $-0^{\circ} 17'$, 1950 co-ordinates. Lick Observatory photograph. (See page 163.)

NOTHING NEW UNDER THE SUN — James C. Corn	159
W. A. COGSHALL	161
THE MINOR PLANETS — Otto Struve	163
NASHVILLE PLANETARIUM	167
AMERICAN ASTRONOMERS REPORT	169
Amateur Astronomers	172
Books and the Sky	173
Gleanings for ATM's	175
Here and There with Amateurs	181
Letters	158
News Notes	162
Observer's Page	177
Planetarium Notes	168
Southern Stars	182
Stars for May	183
Terminology Talks	168

BACK COVER: A portion of the moon at 17 days, with the Aridaeus cleft running downward from the center, and Hyginus, sharply bent, stretching out from the crater Hyginus. The Hyginus cleft may be seen in a 2-inch telescope. This is the northwest central portion of the moon, and the photograph was taken with the 100-inch telescope, one-half second exposure. Mare Vaporum is the dark area extending outward from the right side of the picture. Mount Wilson Observatory photograph.

SKY AND TELESCOPE is published monthly by Sky Publishing Corporation, Harvard College Observatory, Cambridge 38, Mass. Entered as second class matter, April 28, 1939, at the Post Office, Boston, Mass., under Act of March 3, 1879; accepted for mailing at the special rate of postage provided in Paragraph 4, Section 538, Postal Laws and Regulations.

Subscriptions: \$4.00 per year in the United States and possessions, and to Latin-American countries; \$7.00 for two years. Add \$1.00 per year for Canada and for all other foreign countries, making the total subscription \$5.00 per year and \$9.00 for two years. Canadian and foreign remittances should be made in United States currency. Single copies, 35 cents. Circulation staff: Betty G. Dodd, manager; Nancy R. Bolton; Virginia K. McAuliffe.

All notices of change of address must be sent three weeks in advance and accompanied by old and new address, or we cannot make the proper change. When sending your renewal order, or writing in regard to your subscription, your current mailing address must be given. For most efficient handling of your subscription, please return our bill form with your renewal payment.

Editorial and advertising offices: Harvard College Observatory, Cambridge 38, Mass. Unsolicited articles and pictures are welcome, bearing adequate return postage, but we cannot guarantee prompt editorial attention, nor are we responsible for the return of unsolicited manuscripts.



Edgar Allan Poe, 1809-1849.

UPON LEARNING of a new discovery, and finding that it had at least been suspected and perhaps was the object of speculation in the past, our thoughts revert to the old saying, "There is nothing new under the sun." Alexander von Humboldt wrote, about 1848, that many of the discoveries of his time were known to earlier generations, but on less firm grounds. At this point we must carefully distinguish between *evidence* and *proof*.

In Edgar Allan Poe's poem, "The Raven," he mentions reading "many a quaint and curious volume of forgotten lore." It develops that he had been reading the works of the world's greatest astronomers, as indicated in his "Eureka," a long essay that discusses the state of astronomical knowledge up to 1848. The observations, reasoning, and logic contained in his book will be drawn on heavily in the following paragraph.

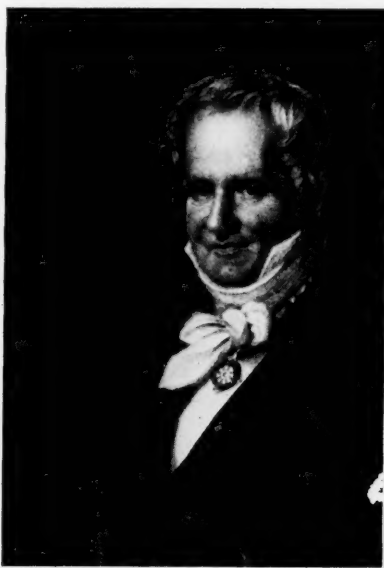
There is no such thing as proof. In order to prove that certain phenomena result from certain causes it is first necessary to prove that no other causes can produce the same results. The object of proof is conviction, and conviction is based on evidence. If one is convinced of a truth, no amount of additional *evidence* can add to his *conviction*. Evidence sufficient to convince one intellect may fail to impress another. Sometimes we seek confirmation where none is needed. There may be more than one road to truth. The first is consistency; the other may be through error, as Laplace was led through error in attempting to explain the origin of the solar system to a more plausible theory on galaxies. The mental processes by which certain correct conclusions were reached in the early periods of astronomy are unknown to us. For want of better evidence, we will call

Nothing New Under the Sun

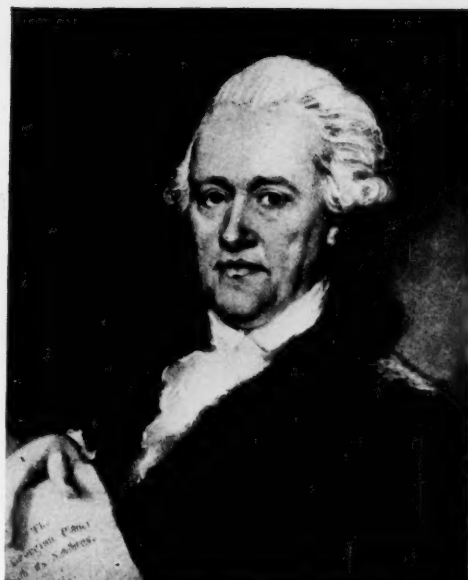
BY JAMES C. CORN

these processes guesses. Poe puts it this way, "The point to be considered is, *who* guesses. In guessing with Plato, we spend our time to better purpose, now and then, than in hearkening to a demonstration by Alcmaeon."

In guessing with Sir William Herschel, we are, perhaps, in the former class. Dr. J. P. Nichol, professor of astronomy, University of Glasgow, wrote in 1839 of Sir William, "This great inquirer was most deeply penetrated with an enduring conviction of the all-prevalence of Law, . . . and he evinced a marvelous quickness and solidity of judgment in interpreting the remotest hints; a feature — a single line was enough, and he divined the outline of the portrait." Herschel conjectured that certain double stars were actually binary, revolving in definite orbits. Nichol continues, "Herschel, however, was too sound a philosopher to be withdrawn even by the fascination of so brilliant a conjecture, from that laborious path which alone can guide to truth." Herschel confirmed this theory by ample observations.



Baron Alexander von Humboldt, 1769-1859. This is the frontispiece of Vol. I of the English edition of "Cosmos," published by Henry G. Bohn in 1860, from which the quotations here were also taken.



Sir William Herschel, 1738-1822.

Modern books teach that the 19th-century astronomers were not certain whether or not the spiral nebulae were in our own Milky Way system. However, Poe states that light from some nebulae takes three millions of years to reach us. "This calculation, moreover, is made by the elder Herschel, and in reference merely to those comparatively proximate clusters within the scope of his own telescope. There are 'nebulae,' however, which, through the magical tube of Lord Rosse, are this instant whispering in our ears the secrets of a *million of ages* by-gone. In a word, the events which we behold now — at this moment — in those worlds — are the identical events which interested their inhabitants *ten hundred thousand centuries ago*."

This is 100 million light-years, a reasonable extreme range of Lord Rosse's 72-inch mirror, a guess, perhaps, but remarkably accurate. However, Herschel employed a "yardstick" of sorts, and based his calculations on observations. Still, it could not have compared with the accurate yardstick provided by the Cepheid variables. It seems likely that those nebulae which he considered to lie at a distance of three million light-years were those in the Virgo cluster, as he is known to have examined several hundred in this group, which we now consider to be at a distance of about eight million light-years.

In 1904, Kapteyn, of Holland, announced the discovery of two star "streams" in the Milky Way system, based on sufficient observations. It is now generally considered that the 19th-century astronomers were unaware of any regularity in the motions of the stars outside of that apparent movement



Sir John Herschel, 1792-1871.

occasioned by the motion of our solar system through space. Von Humboldt, in 1849, wrote, "If we consider the proper, and not the perspective motions of the stars, we shall find many that appear to be distributed in groups, having an opposite direction;..." and, "The proper motion of the stars was in some degree recognized as a general fact, even in the middle of the last century;..."

Present-day astronomers calculate the period of rotation of our galaxy at 200 to 250 million years. Maedler wrote, according to Poe, that all the systems of our cluster Milky Way revolve about the center in 117 million years. His greatest error, perhaps, was in assigning the center of revolution to be in the

Pleiades, rather than in the constellation of Sagittarius.

Sir John Herschel had a remarkable grasp of the problem of globular clusters, about which Dr. Bart J. Bok, of Harvard Observatory, has written so effectively in the July-August, 1951, issues of this magazine. Sir John wrote, in 1833, "It is difficult to form any conception of the dynamical state of such a system. On the one hand, without a rotatory motion and a centrifugal force, it is hardly possible not to regard them as in a state of progressive collapse. On the other, granting such a motion and such a force, we find it no less difficult to reconcile the apparent sphericity of their form with a rotation of the whole system round any single axis, without which internal collisions would appear to be inevitable."

Of the satellites of Uranus, von Humboldt stated that six were discovered by Sir William Herschel, and he gives the dates. However, only two were confirmed by other astronomers at the time. Five are now known to exist, the fifth having been discovered by Kuiper at the McDonald Observatory in 1948. It is difficult to determine now, with certainty, just how many moons Sir William actually saw. He used a mirror of 48-inch diameter, which, theoretically, should have had high light-gathering and resolving power. He stated that on certain rare nights, three or four a year, when the atmosphere was perfectly clear and steady, it hardly seemed possible to place an upper limit on the amount of magnification that could be employed. He knew the limitations of his instrument, the amount of light loss in the mirror, and the errors into which an observer might fall through hasty or careless observations. However, his son, Sir John, in listing the six satellites reported by his father, placed a question mark beside all but two in his later books.

We quote again from Humboldt, "...August 14th, 1850, Lassell discovered a second satellite [of Neptune], for the examination of which he employed a magnifying power of 628. This last discovery has not, I believe, been confirmed by other observers." Lassell, at the time, was using a telescope with a 24-inch mirror of 20 feet focal length. The second satellite of Neptune was discovered by Kuiper at the McDonald Observatory in 1949. Its magnitude (photographic 19.5) renders it extremely unlikely that it was seen by Lassell.

In *Scientific American*, September, 1950, Dr. Harlow Shapley, in an article on the progress of astronomy during the first half of this century, while speculating on possible future discoveries, writes: "Perhaps the other planets do have Saturnian rings that would be 'visible' if we could devise the proper

optics." Humboldt relates, "Soon after the first discovery of Neptune by Galle, a ring was ascribed to him by Lassell and Challis [assistant to Airy at the Royal Observatory]... but subsequent investigations have, as long before, in the case of Uranus, contradicted the opinion of the existence of a ring around Neptune."

The ratio of distances between the sun and the planets was observed a century and a half before Titius and Bode, by Kepler, although he did not express it as a mathematical law. In 1596, at the age of 25, Kepler wrote respecting a space to be filled between Mars and Jupiter, "When this plan therefore



Is the ring system of planet Saturn not unique, perhaps?

failed, I tried to reach my aim in another way, of, I must confess, singular boldness. Between Jupiter and Mars I interposed a new planet."

In Dr. Otto Struve's article on "The Origin of Comets," *Sky and Telescope*, February, 1950, he speaks of clouds of comets, perhaps 100 billion of them in Oort's outer cloud. Kepler said, according to Humboldt, that there were more comets in the regions of space than fishes in the depths of the ocean. This represents a lot of space, a lot of comets, and someone is sure to remark, a lot of fish. However, in Humboldt's time some 700 comets had been recorded, and the orbits of about 150 had been computed.

One of Einstein's latest efforts at scientific achievement is to connect all phenomena of the universe with a single formula, but this has been the subject of speculation for many generations. Humboldt writes: "... we see working in the eternal round of material phenomena an ever-unsatisfied change, presenting itself in numberless and nameless combinations.... Exciting motion in immeasurably minute spaces, this heterogeneity of matter complicates all the problems of terrestrial phenomena. ... In order to carry out the work of



Johannes Kepler, 1571-1630.

the Cosmos within the appropriate limits, and not with too great extension, it must not be attempted to establish theoretically the connection of phenomena."

More startling are the words of Laplace, published in 1814, quoted from the *Source Book in Astronomy* by Shapley and Howarth, "Given for one instant an intelligence which could comprehend all the forces by which nature is animated and the respective situation of the beings who compose it—an intelligence sufficiently vast to submit these data to analysis—it would embrace in the same formula the movements of the greatest bodies of the universe and those of the lightest atom...."

Poe, too, had an idea on the subject, and summed it up with the following remarks: "Discarding now the two equivocal terms, 'gravitation' and 'electricity,' let us adopt the more definite expressions, 'attraction' and 'repulsion.' ... *No other principles exist. All phenomena are referable to one, or to the other, or to both combined...* for all merely argumentative purposes, we are fully justified in assuming that matter *exists* only as attraction and repulsion—that attraction and repulsion *are* matter...."

We must agree with Dr. Shapley, that the present-day astronomer should read the classics of his science. Here and there a clue may be picked up which will be the key to the solution of future problems.

ASTRONOMERS TO MEET AT VICTORIA

By invitation of the director of the Dominion Astrophysical Observatory, Dr. R. M. Petrie, the 87th meeting of the American Astronomical Society will be held jointly with the Astronomical Society of the Pacific in Victoria, B. C., Canada, June 25-28, 1952. This will be the first occasion on which the societies have met in Victoria.

The first annual lecture in honor of the late Dr. R. G. Aitken, established by the Astronomical Society of the Pacific, will be given the evening of June 25th. Dr. R. R. McMath, director of the McMath-Hulbert Observatory, will speak on "Solar Research at the McMath-Hulbert Observatory."

A symposium on emission-line stars will be held on the afternoon of the 26th. Following the symposium, a plaque will be dedicated in honor of Dr. J. S. Plaskett, first director of the Dominion Astrophysical Observatory.

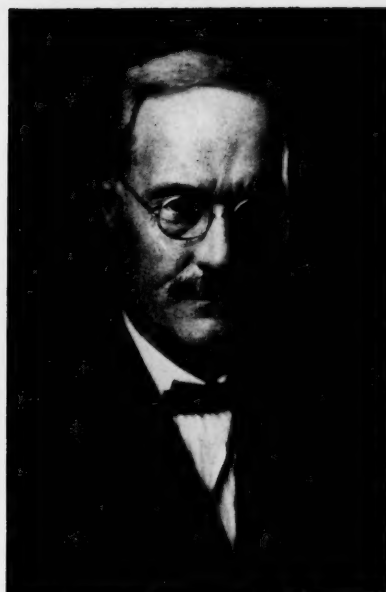
Members of the two professional societies have been invited to attend the Northwest regional meeting of the Astronomical League, to be held in Portland, Ore., June 20-22.

W. A. COGSHALL

WILBUR ADELMAN COGSHALL was born on the 8th of February, 1874, son of a Methodist minister of Mendon, Mich. He was graduated from Albion College in 1895, and in 1896 he joined Percival Lowell's initial and youthful staff, which consisted of A. E. Douglass and T. J. J. See, with the Sykes brothers as engineers and builders. During Cogshall's connection with the Lowell Observatory, its principal instrument, the 24-inch Clark refractor, was used in the winter of 1896-97 near Mexico City, but otherwise, as now, at Flagstaff, Ariz. Cogshall was assistant to See, and his work consisted chiefly of the discovery and micrometric observation of double stars, in which he developed skill and acuity.

In 1900 he became instructor in astronomy at Indiana University, where John A. Miller was head of the department and director of the new Kirkwood Observatory. Upon Miller's departure for Swarthmore College in 1906, Cogshall, then assistant professor, was placed in charge of the department and made director of the observatory, and he remained so until his retirement, as professor, in 1944. In his early years at Indiana, in addition to teaching, he continued to observe double stars, in collaboration with Miller at the 12-inch Kirkwood refractor. In 1903-04, during a leave of absence, he worked with G. W. Ritchey at the Yerkes Observatory in the optical shop and in photographic observations with the excellent 24-inch reflector that Ritchey had recently constructed. His interest in celestial photography and practical optics, thereby stimulated, remained fruitful throughout the rest of his life.

He especially enjoyed pioneering with high-speed mirror systems suited to the photography of nebulae and comets. Doubtless his most important piece of optical work was the construction of a Schwarzschild-type reflecting telescope of 24 inches aperture, which he completed in 1938. The optics of this instrument are good, for short-exposure star images are sharp over the whole plate; but long exposures were unfortunately affected by flexure in the guiding device, a mechanical fault which cost Professor Cogshall much time and which it seems that he had not overcome before retiring. He made many other optical instruments, including a 12-inch Schmidt camera and an excellent pyrex flat for optical testing, both of which are now at the Lowell Observatory. After retirement he lived at Rockford, Ill., where he continued his optical work and was consultant in optics for a war-industry firm. During many of his later years he was afflicted with rheumatism which, with complications, led to



Wilbur Adelman Cogshall, 1874-1951.

his death on October 4, 1951, at the age of 77.

Cogshall photographed the sun's corona at four total solar eclipses: with Miller and some of their students in Spain in 1905 and in Colorado in 1918; independently as leader of an expedition into Lower California in 1923; and in 1929 as scientific head of the expedition sent by the U. S. Naval Observatory to the Philippines. He collaborated with the U. S. Census Bureau by finding and marking the geographic center of population of the United States for each 10-year census from 1900 to 1940.

It was on Cogshall's recommendation that V. M. Slipher went from Indiana University to the Lowell Observatory in 1901, C. O. Lampland in 1903, and E. C. Slipher in 1906. Their work, as is well known, has kept the Lowell Observatory in a high place among the world's astronomical institutions. In 1905, Lowell founded the Lawrence fellowship to enable graduates of Indiana University to study for a year at Flagstaff.

Professor Cogshall was a kindly man who always had time for the companionship of his family and friends, and his contacts with students extended far beyond the classroom. He enjoyed summer vacation trips with his family, often including a stay at the Lowell Observatory for scientific discussion and to be among the scenes where his family life began. It was at Flagstaff that he was married, in 1899, to Harriet Bayliss. She passed away in 1939, and they are survived by two sons and a daughter, all of them graduates of Indiana University.

JOHN C. DUNCAN
Steward Observatory

NEWS NOTES

A MODEL FOR SPIRALS

Suppose the initial form of a galaxy is a cylindrical bar of material (presumably dust and gas), long and thin, at the center of which is a spherical nucleus which is small compared to the length of the bar. The bar turns about three degrees in a million years, rotating as a unit, like a rigid body, but as stars are formed, during perhaps this same interval, they break out of the bar and follow orbits of their own. The bar disintegrates and the typical spiral form of a galaxy eventually results.

This is the picture discussed by Drs. G. C. McVittie, Queens College, London, and Cecilia Payne-Gaposchkin, Harvard Observatory, in the *Monthly Notices of the Royal Astronomical Society*, 111, 506. They construct a model of a spiral galaxy based on Newtonian mechanics. The orbits of the stars are elliptical, their points of closest approach to the center of the galaxy (perigalactica) and farthest points of recession (apogalactica) lying on the initial position of the bar. The spiral arms observed are not orbits, but simply lines along which many of the stars are at present distributed.

On the basis of this theory, the shape of a galaxy alone does not determine the age of the arms, but the shape combined with the rotational velocities does. The arms may lead for part of their extent, and trail for the remainder. The model appears to fit available data on several important galaxies, including our own.

LUNAR EROSION

In the *Publications of the Astronomical Society of the Pacific*, Konrad Buettner, of the Air Force School of Aviation Medicine, Randolph Field, Tex., presents an interesting study of lunar surface conditions based on Pettit and Nicholson's temperature measurements at the lunar eclipses of 1927 and 1939. On the surface of the moon, where atmospheric erosion is essentially absent, radiative erosion is at a maximum. Jaeger and Harper had previously found that less than five per cent of the moon's surface is bare rock. From studies by himself and others, Dr. Buettner concludes that the surface material on the mountain slopes is about the same as that on the level surfaces. Meteoric dust could hardly account for this condition; for the high impact velocities of meteors should cause such material (along with the ejected lunar fragments) to slide down the mountainous slopes. Temperature erosion is also inadequate.

In the absence of an appreciable atmosphere, however, cosmic rays and solar protons, X-rays and ultraviolet

By DORRIT HOFFLEIT

rays strike the moon directly. During the assumed lunar lifetime (10^9 years), probably cosmic rays would have made "nearly one hit per crystalline bond of the surface," penetrating some 10 to 20 centimeters of rock, using up a large part of their energy in converting nuclei, while some of the remaining energy would produce strong ionization. There could result a disintegration of the crystalline structure.

These effects and the accumulation of meteoric dust in the maria could produce progressive changes in color on the lunar surface. Many minerals are darkened by ionizing radiations. The lunar rays, radiating out from the "younger" craters, may therefore be recently ejected matter; older craters lack the rays because the material ejected by the original meteoritic impacts would have had time to become darkened by the ionizing radiations.

POLARIZATION OF 551 STARS

Dr. John S. Hall, using the 40-inch Ritchey-Chretien reflector of the U. S. Naval Observatory, with a Glan-Thompson prism rotated at 15 cycles a second and passing the light through a 1P21 photomultiplier, has measured the polarization of 551 distant stars whose colors had previously been determined by Stebbins, Huffer, and Whitford at the Washburn Observatory. His provisional results are reported in the *Journal of the Optical Society of America* for December, 1951.

Many of the stars are appreciably reddened by interstellar absorption. It was interesting to test whether polarization for them would be associated with the reddening, since interstellar dust might be responsible for both. Dr. Hall found a tendency for the plane of polarization to be perpendicular to the galactic plane, and for the amount of polarization to be greater at low than at high galactic latitudes. In some regions of the Milky Way the planes of polarization for various stars were practically parallel (as in Perseus), while in other directions the planes seemed to have a nearly random distribution (as in Sagittarius and Cygnus).

In the regions of the random polarization, Dr. W. S. Adams at Mount Wilson had previously found complex interstellar lines in some of the stellar spectra, indicating the existence of several discrete interstellar clouds between us and those stars. In such cases the total amount of polarization appears small, suggesting that the orientation of the reflecting particles is different in the various clouds. Thus, it is possible to record very little net polarization where actually there may be much reflecting material. Similarly, while Dr. Hall

found a general increase of reddening with polarization, in individual cases this may not hold, for as starlight passes through a series of clouds the reddening is always additive, whereas the polarization is not necessarily so. Since interstellar clouds are irregularly distributed, it is difficult to establish any definite relation between polarization and distance.

MORE ON WHITE DWARFS

In the *Astronomical Journal*, Sarah Lee Lippincott, Sproul Observatory, has compiled a list of those white dwarfs and degenerate stars for which trigonometric parallaxes have now been determined. With but two exceptions (for which the parallaxes are indeterminate), the parallaxes are $0''.04$ or larger, up to $0''.38$, indicating distances from 80 light-years to as near as Sirius, nine light-years. The absolute magnitudes and color indices of these and other similar stars are related in the manner shown by Dr. W. J. Luyten's chart published on page 140 last month.

Only for the companions of Sirius and Procyon and for α_2 Eridani B are the masses fairly well determined, even though other white dwarfs are members of visual binary systems so that it might be possible to solve for their masses. But the periods are too long for significant data to have been acquired, or the separation of the components is unfavorable.

In one particular case, the visual double star ζ Cancri has a distant companion. The motion of this third star is perturbed, presumably by a white dwarf companion that revolves once in about 17.6 years. This fourth star of a quadruple system might possibly be observed with a large telescope.

IAU SYMPOSIA IN ROME

The eighth general assembly of the International Astronomical Union is scheduled for September 4-13, 1952, in Rome. A number of symposia are planned, including instrumentation and the astrometry of faint stars.

Of particular interest will be the symposium on stellar evolution. The committee secretary for this symposium, E. Schatzman, of Paris, has indicated tentatively that the following subjects will be covered: the role of stellar rotation and close doubles in stellar evolution; diffuse nebulae and their bearing on stellar evolution; corpuscular radiation as a fundamental factor in stellar evolution; dark nebulae and accretion phenomena; the formation of proto-stars; stellar rotation and fission; chemical composition and evolution; the evolution of white dwarfs.

After the close of the regular meetings, a symposium on solar phenomena will be held in Rome and Florence.

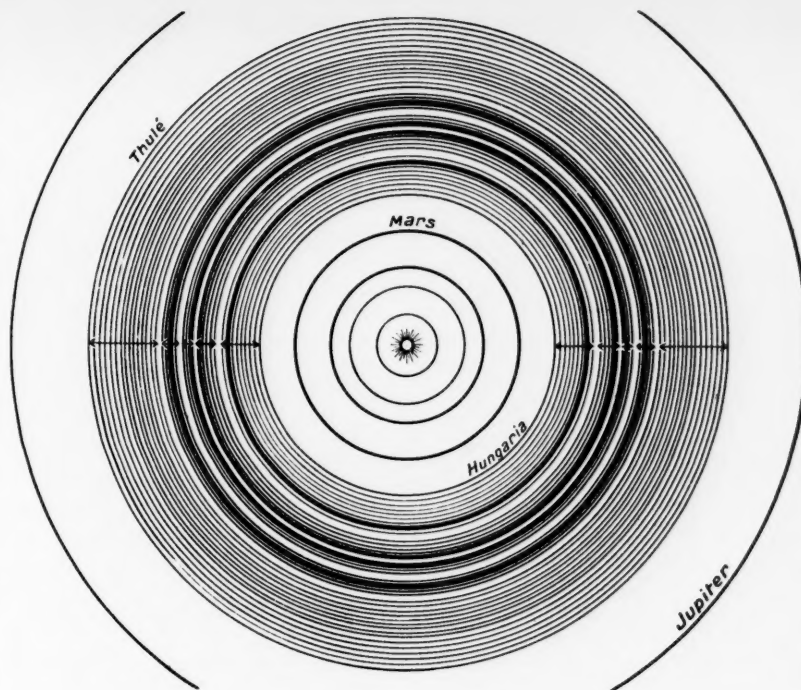
IN 1772 J. E. Bode, later director of the Berlin Observatory, for the first time clearly enunciated his belief "concerning the probable existence of other planets in the solar system than had up to this time been known." What, for example, could be the reason "for the great space which is found between Mars and Jupiter, where until now no major planet is seen? Is it not highly probable that a planet actually revolves in the orbit which the finger of the Almighty has drawn for it?"

If we designate the distance of Saturn from the sun by the number 10, in astronomical units, the distances of the planets are indicated by the following system, apparently discovered by Titius and "popularized" by Bode:

Mercury	0.4	+	0.0	=	0.4
Venus	0.4	+	0.3	=	0.7
Earth	0.4	+	(0.3 x 2)	=	1.0
Mars	0.4	+	(0.3 x 2 ²)	=	1.6
?	0.4	+	(0.3 x 2 ³)	=	2.8
Jupiter	0.4	+	(0.3 x 2 ⁴)	=	5.2
Saturn	0.4	+	(0.3 x 2 ⁵)	=	10.0
Uranus	0.4	+	(0.3 x 2 ⁶)	=	19.6
Neptune	0.4	+	(0.3 x 2 ⁷)	=	38.8

The discovery of Uranus in 1781, an unknown planet at the time of Bode's work, was "the first happy verification of it." It stimulated the organization of a systematic search for a planet whose distance from the sun would be close to 2.8 astronomical units. But before the co-operative work could be started, Giuseppe Piazzi in Palermo accidentally found, on January 1, 1801, a moving starlike object of the 8th magnitude in the constellation Taurus. Its motion was retrograde (from east to west), but by the middle of the month it had become stationary, and then it reversed its direction (moving from west to east). On January 24th Piazzi wrote to Bode and gave him the observed positions of the new object, which was described as "without any noticeable nebulosity."

Ordinarily, it would require a fairly laborious computation to determine the orbit of a new planet, from at least three observations; and such an orbit



A schematic representation of the orbits of the asteroids, in which they are shown as circles although actually they have various eccentricities. Asteroids of unusual orbits have been omitted. Note the concentrations at certain distances from the sun, and Kirkwood's gaps at other distances. Adapted from "L'Astronomie," by Rudaux and Vaucouleurs.

THE MINOR PLANETS

BY OTTO STRUVE, *Leuschner Observatory*
University of California

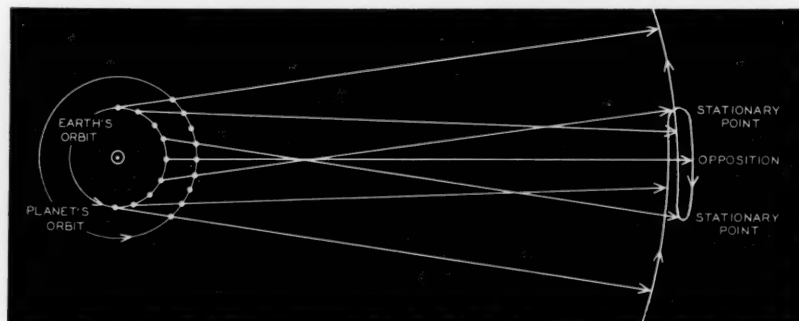
was actually calculated a few months later by Gauss in a celebrated memoir which, for the first time, established the now familiar method used by computers the world over. But Bode was not to be deterred by any such delay as might be required to find the elements of the planet's path. In the words of Miss Agnes M. Clerke (*A Popular History of Astronomy of the 19th Century*, page

92, 1887), he, "unabashed by speculative scorn, had scarcely read Piazzi's letter when he concluded that it referred to the precise body in question."

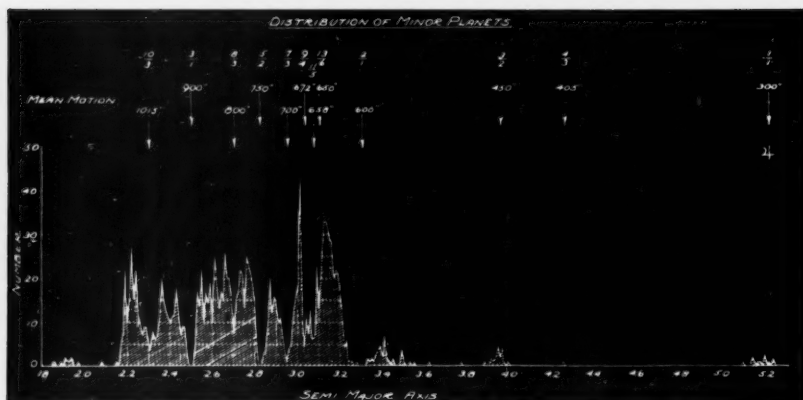
Undoubtedly Bode realized, as we do today, that from the apparent motion of a planet across the sky, and from the angular extent of the retrograde loop of the planet's motion at opposition, it is possible, with reasonable certainty, to infer the solar distance of the planet. Even a crude picture of a part of the loop of Piazzi's new planet would suffice to convince any experienced observer that its distance must be intermediate between those of Mars (1.6 A.U.) and of Jupiter (5.2 A.U.). Bode thus boldly proclaimed that the missing planet at 2.8 A.U. had finally been found!

His consternation must have been great when only a year later Olbers discovered another faint planet, also at about 2.8 A.U. from the sun! Named Ceres and Pallas, respectively, the two formed the beginning of a new and exciting branch of astronomy — the study of the minor planets.

The latest catalogue of the orbits of



The size of the retrograde loop of a superior planet against the sky depends on its distance from us and its orbital velocity. The loop is largest for Mars, but is completed in the shortest time; for Jupiter the loop is shorter, but requires more time. Normal asteroids, such as Ceres, describe loops that are shorter than Mars', but take less time than Jupiter's loop.



The distribution of the asteroids according to their mean motions and the sizes of their orbits, for 1,563 minor planets listed in the ephemeris volume for 1947. The three groups with periods close to that of Jupiter are on the right. Yale University Observatory diagram.

all known minor planets and of their ephemerides for 1952, which has recently arrived from the Soviet Union, contains nearly 1,600 entries. Many more asteroids have been observed, but have not been catalogued because the observations made during the discovery season were not accurate enough or did not cover a sufficiently long interval of time to give a reliable prediction of an object's position in future years.

Until 1944, the numbering of the planets and their naming was the responsibility of the Copernicus Institute in Berlin, but since 1948 this task has been assigned, by the International Astronomical Union, to the Cincinnati Observatory, under Dr. P. Herget. A newly found planet is at first designated by the year of discovery and by two letters, the first for the current half-month of the year (omitting I), and the second for the order number of discovery within this half month. Thus, 1949 MA stands for the first minor planet discovered in the second half of June, 1949. When the Cincinnati Planet Center deems it appropriate, the planet is given a regular number, under which it appears in the subsequent literature.

The original plan of giving these objects mythological names soon had to be abandoned. Although it is still customary to attach proper names to the numbered planets, these are no longer derived in any consistent manner. You may find among them famous astronomers, and not so famous ones; you also find the names of observatories and cities; and if you study them carefully you will discover some politicians (852 Wladilena, for Wladimir Lenin), some astronomers' sweethearts, and even the dog and pet goat of one of the great planet discoverers of a former generation, all commemorated in the sky for the benefit, perhaps, of future generations of psychologists, rather than astronomers!

It has been asked from time to time whether the tremendous effort of com-

puting the orbits and slow perturbations of so many minor planets is really justified. It seems a hopeless task, considering that the number of new discoveries continues to increase—even though in very recent years the Cincinnati center has been more exacting than its predecessor in demanding adequate observations before a planet is accepted in the catalogue. Perhaps it is like counting the grains of sand on the beach!

But the information which astronomy has gained and expects to gain from the minor planets is very great. Undoubtedly, the work must continue, essentially along present lines, and the difficulties of the computers must be overcome by developing more efficient methods and faster computing machines. There has already taken place a revolution of computational astronomy, through the introduction of punched-card methods and other timesaving devices, and further improvements should make the work even more efficient.

Nevertheless, discoveries of new minor planets are not encouraged at the present time, unless they are unusual in some respect. Dr. J. Greenstein related not long ago to the author that the 48-inch Schmidt telescope at Mount Palomar records on a single exposure of moderate length some 50 to 100, or even more, moving objects near opposition to the sun. Only some 15 of these are already known. No wonder, then, that a planet trail "must be an inch long, or must be directed the wrong way" in order to compel the attention of the Pasadena astronomers! At the Lick Observatory as well, where the 20-inch astrographic camera is surveying the sky for galaxies, C. D. Shane and C. A. Wirtanen have found numerous asteroids on their wide-field plates (see the front cover), resulting in the discoveries of some unusual bodies.

Almost as soon as Olbers had found the planet Pallas, he expressed the opinion that this new object and Piazzi's Ceres were the fragments of a single

larger planet which in some unknown manner had exploded in the early stages of the life of our solar system. In one form or another this exciting hypothesis has persisted through the years, and at the present time it has taken on new luster through the work of four independent investigators: D. Brouwer at Yale, G. P. Kuiper at Yerkes, I. I. Putilin in Kiev, and Mrs. N. Samoilova-Yakhontova in Leningrad.

Ever since Daniel Kirkwood, of Indiana University, followed his brilliant "hunch" and announced in 1866 the existence of certain gaps in the distribution of the minor planets with respect to their distances from the sun, it has been known that these objects present some remarkable statistical relationships. (An account of Kirkwood's work by Helen Sawyer Hogg appeared in the July-August, 1950, issue of the *Journal* of the Royal Astronomical Society of Canada.)

The periods of the asteroids and their mean motions ($360^\circ/\text{period}$) are directly related to their distances from the sun through Kepler's third law. At the top of the diagram we see indicated certain simple fractions that give the ratio of the mean motion of the minor planets to that of Jupiter. We see that when this ratio is a simple fraction, for example, $3/1$, there are very few objects in the corresponding part of the distribution curve. Similar minima occur at $5/2$, $7/3$, $2/1$, and so forth. They are explained by the gravitation of Jupiter, which disturbs the orbit of such a planet in precisely the same way every three cycles of the minor planet, for example, when the ratio is $3/1$. When the ratio is not a simple fraction, we say that there is no *commensurability* of the motions of Jupiter and the minor planet—the perturbing action of the former upon the latter is sometimes one way and sometimes another, so that it tends to cancel out and leave the motion unchanged for relatively long intervals of time.

It is not possible to describe the effects of Jupiter's perturbations qualitatively. Kirkwood's gaps cease to exist when the mean motion is close to that of Jupiter. For example, when the critical ratio is $3/2$ (type of Hilda), $4/3$ (type of Thule), $1/1$ (Trojans), there are accumulations of objects, rather than gaps. These maxima in the distribution were explained by the Japanese astronomer Hirayama as a direct consequence of the laws of three-body motion.

The importance of these and other similar investigations was to show that the perturbations produced by Jupiter and other planets, working over perhaps several billion years, have materially affected the distribution of the minor planets and their motions. It is, therefore, not surprising that the present or-

bits do not even approximately intersect in one point—as would otherwise be the case if these objects were the fragments of a recent planetary catastrophe.

Nevertheless, there are two phenomena which suggest a recent explosion. First, we know from the work of Mascart and, more recently, of Fayet, in France, that there are several pairs of minor planets with remarkably similar orbits. An example taken from a recent monograph by Mrs. Samoilova-Yakhontova is the pair 1026 and 1056. Not only are the mean motions almost the same (1,053" and 1,065"), but the inclinations, the eccentricities, and the orientations of the major axes are almost indistinguishable. It is probable that such a similarity in the two orbits cannot be the result of chance, and the suspicion arises that the process of fragmentation, which may have started long ago when the solar system had just been formed, is a continuing one, and that larger fragments may have broken up into smaller pieces, at relatively recent times.

This point of view has been greatly strengthened by Hirayama's discovery of planet families—groups of objects which, though not now possessing orbits that are as similar to each other as are those of 1026 and 1056, nevertheless preserve some vestiges of a similarity in motion that must have been very conspicuous some millions of years ago. As was shown by Hirayama, and more recently by Brouwer, the present orbital elements may differ widely as the result of perturbations by Jupiter and other planets, even though these elements contain within themselves certain features not easily changed by the perturbations. By an intricate method of celestial mechanics it is possible to derive certain quantities, called the *proper elements* of a planet, which are relatively stable with respect to the perturbations. These proper elements, when computed by Brouwer for all known minor planets, not only greatly increased the numbers of objects belonging to Hirayama's five families, but revealed several entirely new groups of the same sort (see *Sky and Telescope*, September, 1950, page 271). Similar results have also been announced by N. M. Staude in Russia.

We should take care to note, however, that these similar mechanical properties of the planet families do not prove that they necessarily resulted from the breakup of a larger body. As Brouwer has pointed out, most of the families show a remarkable concentration of objects having similar *proper inclinations* and *proper eccentricities*, but a certain quantity designated as $(\pi_1 + \theta_1)$, which in a manner of speaking should indicate the orientation of the major axes of the individual orbits, and, according to Brouwer, is also fairly stable

in regard to perturbations, shows a concentration in only a few families (Flora, Eos, Maria), while in others it is distributed almost at random. Brouwer suggests that "the groups that show concentrations of $(\pi_1 + \theta_1)$ are much more recently formed groups" than are families which have lost this concentration.

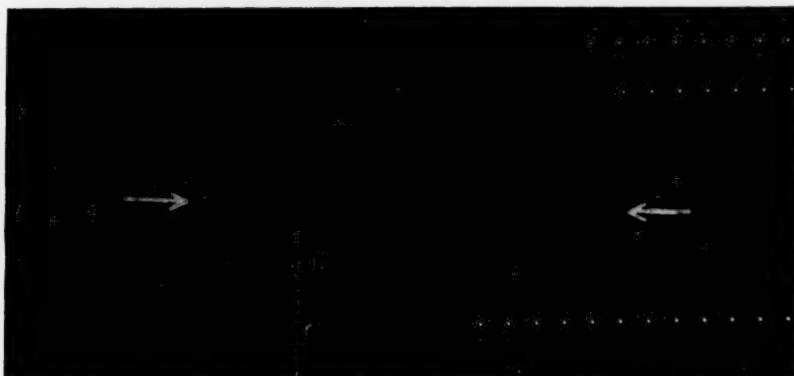
Although it is necessary to heed the opinion of E. W. Brown, expressed in 1932, that "the origin of asteroids circulating between the orbit of Mars and Jupiter cannot be deduced by gravitational methods from their present orbits" and, the "several families which K. Hirayama has found... would appear to be groups of comparatively stable orbits developed by attractive forces... from a great variety of configurations," it is perhaps not necessary to go so far as to abandon "any hope of getting evidence from this source as to whether they were a result of an explosion or collision." As Brouwer has remarked, "Brown's arguments were based upon the assumption of an age of at least two billion years."

The strongest evidence in favor of a collisional origin of the planet families comes from the photometric observations. Several minor planets vary in light. The variation of Eros with a period of five hours 16 minutes, and an amplitude that may be as large as 1.5 magnitudes, or may be almost zero, has been known since 1900 from the work of E. v. Oppolzer. In 1950, Mrs. Samoilova-Yakhontova, following essentially the lines of reasoning of Margaret Harwood in this country, estimated that perhaps two dozen planets have amplitudes greater than a quarter of a magnitude, all with periods of a few hours. There can be little doubt that these variations are caused by the axial rotation of irregular fragments. In the case of Eros the irregular shape was actually observed by van den Bos and Finsen during its close approach to the earth in 1930-31.

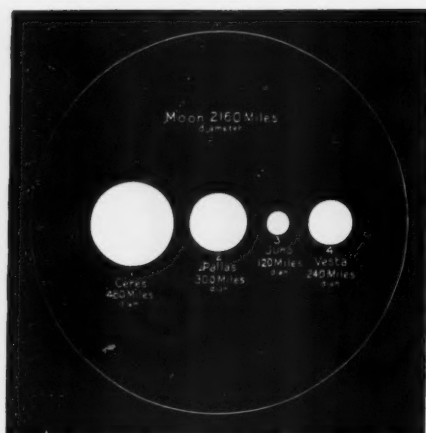
In the last two years a systematic program of photoelectric and photographic observations of numerous minor planets has been conducted at the McDonald Observatory under the direction of Dr. Kuiper. The results of this work have not yet been published, except for the fact that numerous new variations have been found and that "the true period is always more than 3.5 hours,—this is the fastest rotation that the Roche rule allows" (*Observatory*, 71, 90, 1951). Kuiper had previously shown that in the case of a rotating body the ordinary Roche limit (the distance from the sun, or from a large planet, at which tidal forces will disrupt a planet despite the resistance of its own gravitation to this disrupting action) will be greatly modified. For example, in the case of a nonrotating body the Roche limit is about $2\frac{1}{2}$ times the radius of the heavy mass; the minor planets are safe from the sun, and also from Jupiter, except during the closest of approaches to the latter. But when the minor planet spins around its axis, the centrifugal force will reinforce the tidal action and breakup will occur when the product of the period times the square root of the density is about five hours, irrespective of the size of the object. The density is approximately that of rock, say three times that of water. Hence, the critical period is about $3\frac{1}{2}$ hours.

Presumably this computation neglects cohesion, which may become very large indeed for small minor planets. Thus H. Jeffreys and, more recently, E. Opik have found that planets several hundred kilometers in radius are safe from tidal disruption far inside the conventional Roche limit of 2.5 radii. Presumably very small minor planets, and meteors, can and do rotate more rapidly than is indicated by Kuiper's formula. But for larger bodies his expression has the support of the direct observational evidence.

It is of interest that the two largest minor planets, Ceres and Pallas, are



This series of multiple exposures was taken at a time when the asteroid Eros was rapidly fading in brightness. Its images are indicated by the arrows; each exposure was six minutes long. The asteroid's motion with respect to the stars is also shown. Harvard Observatory photograph.



The four largest asteroids are here compared in size with the moon.

constant in light, according to photoelectric observations by W. Calder at Harvard. But Vesta, not so very much smaller, has a well-known and marked variation which has been recently investigated by C. B. Stephenson at Yerkes. H. Haupt, in a summarizing article, concluded that very likely "Vesta is an asymmetrical or spotted body that rotates on a precessing axis."

These results, supported by photographic observations of other workers, may indicate that only the two largest objects in the ring of minor planets are approximately spherical. Perhaps this is a confirmation of Kuiper's theory of the origin of the minor planets which forms a part of his comprehensive cosmogony of the solar system, just published in the McGraw-Hill book on *Astrophysics*. We cannot at this time review this interesting theory, and we can only briefly sketch those parts of it which apply to the formation of the minor planets.

Contrary to the views of Putilin, Kuiper believes that there never was a single major planet in the region of 2.8 A.U. The original solar nebula out of which the planets were formed had, to begin with, a mass of about 1/10 the mass of the sun. Spread in a reasonably attenuating manner from the sun outward, this would produce a density near the present location of Mercury of less than 1/100 the density of the air we breathe, and 100,000 times less at the location of Neptune. Small as these densities are, they very greatly exceed the density of an interstellar gas cloud or a diffuse nebula.

This solar nebula must of necessity revolve around the sun, not like a solid body, but in a manner that has become familiar from the study of the rings of Saturn: the inner parts revolve in shorter periods than the outer. This produces a shearing effect within the gas, and turbulent eddies appear and disappear in a more or less irregular manner, but always with the largest

eddies near the outer boundary of the nebula.

Up to this point the picture does not differ greatly from the earlier theory by von Weizsaecker and its modification by ter Haar. Kuiper's principal contribution was to recognize that without some special mechanism the eddies are not sufficiently long-lived to enable a planetary condensation to start forming. He noticed that the density of the nebula is not much less than what he calls "the critical Roche density." An accidentally formed eddy may well surpass this density and it will then, in effect, become stable against the disrupting effect of tidal forces.

The planets can then begin to form — first as protoplanets which have disk-like shapes and accumulate a large part of the material originally contained in the ring in which the eddy is located. The distribution of the eddy sizes is such that the planets form with their present distances from the sun in obedience to the Bode relation; and their present small masses result from the partial or complete loss of hydrogen and other light gases.

The formation of the largest of the planets, Jupiter, impedes the formation of full-grown planets in the next inner shell. Even Mars may have been dwarfed by the resulting perturbations. In the region of 2.8 A.U. the conditions would have been such as to prevent the formation of a normal planet. Kuiper believes that in the absence of Jupiter the density of the original nebula at 2.8 A.U. would have been sufficient to produce an earthlike planet. In reality several small planets would have been formed — five or even more would not be unreasonable. The largest minor planets, like Ceres, whose radius was measured by Barnard as 384 kilometers, and Pallas, 245 kilometers, are identified with these original small protoplanets.

There would then be an appreciable chance that two or more of them might collide. Because of the similarity of the original motions, the collisions would be of the grazing type, with relative velocities of the order of one kilometer per second, or less. It is remarkable that Brouwer had inferred, from the present distribution of the orbital elements of members of the separate planet families, that the original collisions must have been produced in precisely this manner. In fact, he suggests that "the required velocities are quite small, only about 0.1 km/sec for the more compact families, about 0.3 km/sec for the Flora family, and only slightly more for the Phocaea family."

The probability that any two of the original minor planets collided in three billion years — the lifetime of the solar system — is about 1/10. The probability that at least one pair has experi-

enced a collision is thus considerable. Once a collision between two original planets has taken place, and fragmentation has started, it will proceed at a rapid rate, with more and more small fragments in the system. The end result is about what we observe now: a large number of minor planets. S. V. Orlov believes that there may be a million or more asteroids having radii of the order of one or two kilometers, while Baade and Hubble, from occasional photographs made with the Mount Wilson 100-inch telescope, estimate that the number, to apparent magnitude 19, is somewhat less than 50,000.

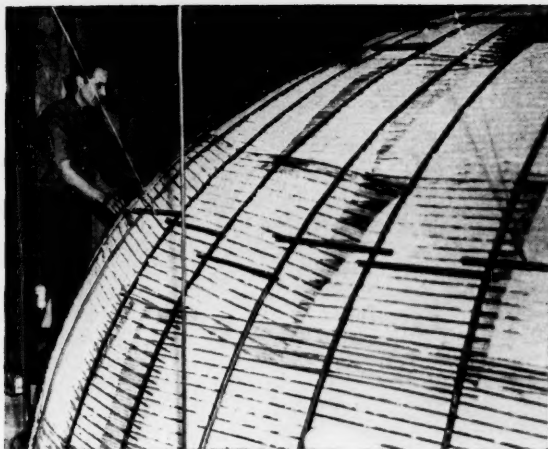
The number of smaller pieces must be enormous; undoubtedly the meteorites are some of these fragments. They usually move in direct orbits, and tend to overtake the earth in their flight; the resulting impacts are therefore often not very violent. Thus the 1947 Sikhotey-Alinsky meteorite in Russia struck the earth with a velocity that was not large enough to evaporate the entire meteorite. Only occasional meteorites, whose orbits have been greatly perturbed by the planets, hit the earth with a large velocity, on its advancing hemisphere. The 1908 Tunguska meteorite was of this kind; it evaporated so completely during the explosion caused by its collision with the earth that no fragments were left on the ground.

OPTIMUM LOCATION OF A PHOTOELECTRIC OBSERVATORY

Under the above title, in *Science* for February 29, 1952, Dr. John B. Irwin, Goethe Link Observatory, Indiana University, describes the advantages of an observatory devoted exclusively to photoelectric astronomy. "If such an observatory were to be established, there is no question but that it would make a very substantial contribution to our astrophysical knowledge at a fraction of the initial cost of a very large reflector."

The observatory should be established on a moderately high mountain in a region of minimum cloudiness, particularly where the sky is clear throughout the night. The highest average number of clear days through the year in this country, more than 300, occurs in a roughly elliptical region extending about 40 miles east and west of Yuma, Ariz., and 80 miles north of it. Palomar and Flagstaff are in zones with nearly 220 clear days a year, and at McDonald Observatory the average number of clear days is 175.

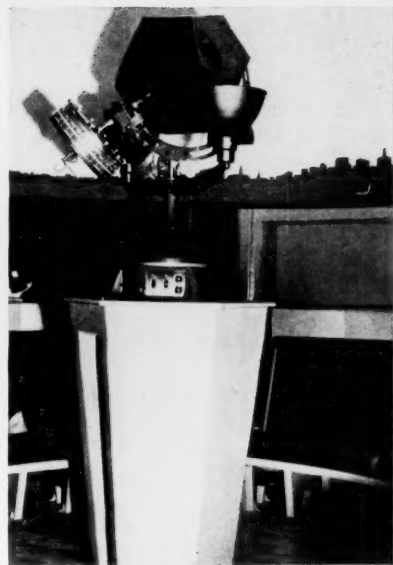
Actual "photoelectric" nights, those entirely without a trace of a cloud, occur an estimated 79 per cent of the time near Yuma, 52 per cent at Flagstaff, 36 per cent at McDonald, and only 12 per cent of the time at the Link Observatory in Indiana.



Left: P. M. Crouch, museum preparator and technician, inspects the construction of the planetarium chamber dome.

Right: The pedestal on which the Spitz projector rests makes a storage box (for which the door panel is not yet in place). Beyond the instrument can be seen the doorway, and an exhibit case is on the right. The skyline is based on photographs.

All photos are by the Nashville Children's Museum.



Nashville Planetarium

ON March 3rd the Children's Museum, Nashville, Tenn., dedicated the Tony Sudekum Memorial Planetarium and Hall of Astronomy. This planetarium, the gift of Mrs. Tony Sudekum, of Nashville, will be a living memorial to one of the city's most generous and public-spirited citizens.

The instrument is a Spitz planetarium. In the construction of the dome and seating area, a number of innovations have been made over other small planetariums. The dome, 21 feet in diameter, is acoustical plaster on a metal-lath framework. The seats, built and installed by our own carpenters, are continuous rather than individual, and form two concentric circular rows, each divided into three segments by one main and two smaller aisles. The seats are pitched at approximately a 60-degree angle for maximum comfort, with backs high

enough to serve as headrests. They are spring-cushioned, with padded backs, completely upholstered in heavy leatherette. The color scheme is deep blue and gray. The walls, for three feet down from the dome, are covered with acoustic tile. These sound-treated walls follow the contour of the dome for half its circumference, then continue straight, making an oblong area of one end of the room, where the entrance is located. Along the remainder of that wall has been built a 16-foot exhibit case.

All lighting and other controls can be operated from the instrument itself or from a booth at one side, where are also located projectors for 16-mm. movies and 35-mm. slides, a tape recorder and a record player.

Planetarium programs will be given for adult and for children's groups. Richard O. Means, who is doing graduate work in physics and astronomy at Vanderbilt University, has been added to the museum staff as planetarium lecturer. As is the case with other museum activities, school teachers will bring their classes during school hours by appointment. Other groups will come in the afternoons and evenings. A wide range of hours is scheduled almost daily, in order to take care of the expected demand (see Planetarium Notes). The demonstrations will be adjusted to the ages of the audience and, where possible, to groups with special interests. In general, two subjects have been announced for each month, alternate topics being repeated the second month with slightly different emphasis and usually under a different title. Subjects for coming lectures are: *May*, Our Sun and Its Family; *What Is a Star?* *June*, What Is a Star? Friends of the Summer Skies. *July*, Finding Your Way at Camp; Shooting Stars. *August*, Shooting Stars, The Milky Way.

WILLIAM G. HASSLER
Director, Children's Museum



Some details of the seat construction and upholstery are being checked.

AURORA IN THE NORTHEAST

A brilliant auroral display occurred on Sunday evening, March 30th, and was reported from several places in the northeastern part of the United States. From Pennsylvania State College, John C. Villforth writes in part:

"A short but very brilliant display was first noticed at the college observatories about 7:45 p.m. EST, when the northern lights interrupted the observing program. The display increased in activity until about 8:15 p.m., at which time it extended through the zenith in curtain shape from the eastern to western horizons; the curtains moved from east to west in an orderly manner. Although not very colorful, it was the most beautiful display seen here in some time. It lasted about three quarters of an hour."

In Boston and vicinity the display started with a homogeneous arc that soon formed rayed bands moving southward to the zenith. Red and green patches were prominent. For several hours after the first brilliant display, auroral features remained visible along the northern horizon.

COMET SCHAUMASSE OBSERVED

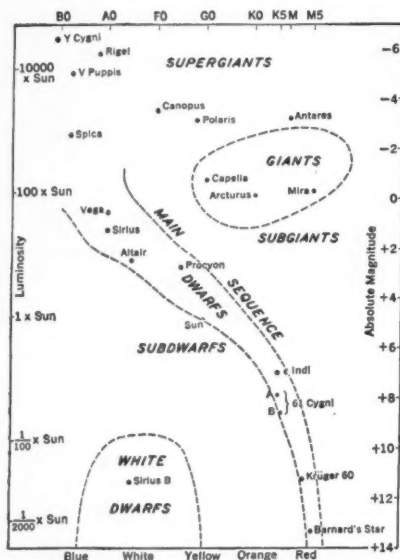
On January 30th, the AAVSO office at Harvard Observatory received a telegram from Robert Adams, Neosho, Mo., reporting a nebulous object of the 9th magnitude in the northern sky. This was periodic Comet Schaumasse, which had been observed in late September and early October by Dr. Leland E. Cunningham, Leuschner Observatory, with the 60-inch Mount Wilson reflector.

At that time the comet was of the 18th magnitude, and its predicted brightness, on the basis of the 4th-power law, was only 12.7 when Mr. Adams made his independent observations. Comet Schaumasse had become much brighter than expected. It has since moved among the stars in the Big Dipper, and has been reported by members of the Eastbay Astronomical Society, Oakland, Calif.

TERMINOLOGY TALKS-J. HUGH PRUETT

Spectrum-Luminosity Diagram

Last month we discussed the various spectral classes of stars. We found that for the classes *O*, *B*, *A*, *F*, *G*, *K*, and *M*, the colors run in order from blue-white to red, indicating a continuous lowering of temperature. As described in Dr. Olin J. Eggen's article in the



The spectrum-luminosity diagram. The main sequence is wide at the top, narrow at the bottom.

November, 1950, issue, page 5, Dr. Henry Norris Russell about 40 years ago devised a diagram that has since proven of fundamental importance in the study of the stars.

In this spectrum-luminosity diagram, the spectral class of a star is plotted against its absolute magnitude or intrinsic luminosity. Of course, there is some "spread" caused by uncertainties in the observational data, but most of the stars are placed in what is called the main sequence, in which the hot blue-white stars of type *B* are by far the most luminous, while the cool red stars of type *M* are the faintest.

It would have been fine if all stars could have been placed in this main-sequence column, but it is not as simple as that. All red stars are not faint—some are very brilliant. They and some of the brightest stars in other classes are called giants—and even supergiants. Among the whiter stars, too, there are some that do not follow the general rule which claims them as very brilliant objects. They are found in the lower left part of the spectrum-luminosity diagram under the name of white dwarfs. Above and below the main sequence are other nonconforming stars, known generally as subgiants and subdwarfs, respectively. Our sun is a main-sequence yellow dwarf.

A great deal can be learned about the stars from a detailed examination of the

accompanying diagram, which has been taken from the well-known textbook, *Astronomy*, by Skilling and Richardson. Stars fainter than those shown here are included in the diagram by W. J. Luyten on page 140 last month, where the individual white dwarf or degenerate stars are shown. The faintest known star is below absolute magnitude 20, or less than a millionth as bright as the sun. On the other hand, stars like Rigel are over 20,000 times the sun's brightness. Ours is indeed an ordinary star.

ON THE BRINK

*An evening at cards . . . and then
These words to my host and hostess,
"A most enjoyable time we've had . . .
You always entertain so charmingly."
Soon the light of their doorway
Guides me out beneath the stars.
The stars!
There's Vega, whose blue-white rays
Gleam across Immensity.
And yonder, Betelgeuse, within whose
sphere
Our earth could run its yearly circle
Without touching!
That hazy thumb-nail patch
Beside the Milky Way,
A glorious galaxy,
A million of light-years away!
Yet here I stand,
A bridge prize 'neath my arm,
On the brink of Infinity.*

ENNIS R. UTTER

Planetarium Notes

BALTIMORE: *Davis Planetarium.* Maryland Academy of Sciences, Enoch Pratt Library Building, 400 Cathedral St., Baltimore 1, Md., Mulberry 2370.

SCHEDULE: 4 p.m. Monday, Wednesday, and Friday; Thursday evening, 7:45, 8:30, 9:30 p.m. Admission free. Spitz projector. Director, Paul S. Watson.

BOSTON: *Little Planetarium.* Boston Museum of Science, Science Park, Boston 14, Mass. Richmond 2-1410.

SCHEDULE: Tuesday through Friday, 3 and 4 p.m.; Saturday, 11 a.m., 2, 3, and 4 p.m.; Sunday, 2, 3, and 4 p.m. Spitz projector. Acting director, John Patterson.

BUFFALO: *Buffalo Museum of Science Planetarium.* Humboldt Parkway, Buffalo, N. Y., GR-4100.

SCHEDULE: Sundays, 2:00 to 5:30 p.m. Admission free. Spitz projector. For special lectures address Elsworth Jaeger, director of education.

CHAPEL HILL: *Morehead Planetarium.* University of North Carolina, Chapel Hill, N.C.

SCHEDULE: Daily at 8:30 p.m.; Saturday and Sunday at 3:00 p.m. Zeiss projector. Manager, A. F. Jenzano.

CHICAGO: *Adler Planetarium.* 900 E. Adams Bond Drive, Chicago 5, Ill., Wabash 1428.

SCHEDULE: Mondays through Saturdays, 11

a.m. and 3 p.m.; Sundays, 2:30 and 3:30 p.m. Zeiss projector. Director, Wagner Schlesinger.

KANSAS CITY: *Kansas City Museum Planetarium.* 3218 Gladstone Blvd., Kansas City 1, Mo., Chestnut 2215.

SCHEDULE: Saturday, 3:30 p.m.; Sunday, 3:00 and 5:00 p.m. Spitz projector. Director, Charles G. Wilder.

LOS ANGELES: *Griffith Observatory and Planetarium.* Griffith Park, P. O. Box 9787, Los Feliz Station, Los Angeles 27, Calif., Olympia 1191.

SCHEDULE: Wednesday and Thursday at 8:30 p.m.; Friday, Saturday, and Sunday at 3 and 8:30 p.m.; extra show on Sunday at 4:15 p.m. Zeiss projector. Director, Dinsmore Alter.

NASHVILLE: *Sudekum Planetarium.* Children's Museum, 724 2nd Ave. S., Nashville 10, Tenn., 42-1853.

SCHEDULE: Wednesday, Saturday, and Sunday, 2, 2:45, 3:30, 4:15. Spitz projector. Director, William G. Hassler.

NEW YORK CITY: *Hayden Planetarium.* 81st St. and Central Park West, New York 24, N. Y., Trafalgar 3-1300.

SCHEDULE: Mondays through Fridays, 2, 3:30, and 8:30 p.m.; Saturdays, 11 a.m., 2, 3, 4, 5, and 8:30 p.m.; Sundays and holidays, 2, 3, 4, 5, and 8:30 p.m.; Wednesdays and Fridays, 11 a.m., for school groups. Zeiss projector. Chairman, Robert R. Coles.

PHILADELPHIA: *Fels Planetarium.* Franklin Institute, 20th St. at Benjamin Franklin

Parkway, Philadelphia 3, Pa., Locust 4-3600.

SCHEDULE: Tuesdays through Sundays, 3 p.m.; Saturdays, 11 a.m.; Saturdays, Sundays, and holidays, 2 p.m.; Wednesdays, Fridays, and Saturdays, 8:30 p.m. Zeiss projector. Director, I. M. Levitt.

PITTSBURGH: *Buhl Planetarium and Institute of Popular Science.* Federal and West Ohio Sts., Pittsburgh 12, Pa., Fairfax 4300.

SCHEDULE: Mondays through Saturdays, 2:15 and 8:30 p.m.; Sundays and holidays, 2:15, 3:15 and 8:30 p.m. Zeiss projector. Director, Arthur L. Draper.

PORTLAND, ORE.: *Oregon Museum of Science and Industry Planetarium.* 908 N.E. Hassalo St., Portland 12, Ore., East 3807.

SCHEDULE: Saturday, Sunday, and Wednesday, 4:00 p.m.; Tuesday, Thursday, and Friday, 8:00 p.m.; Saturday show for children only, 10:30 a.m. Spitz projector. Director, Stanley H. Shirk.

SPRINGFIELD, MASS.: *Seymour Planetarium.* Museum of Natural History, Springfield 5, Mass.

SCHEDULE: Tuesdays, Thursdays, and Saturdays at 3 p.m.; Tuesday evenings at 8 p.m.; special star stories for children on Saturdays at 2 p.m. Admission free. Korkosz projector. Director, Frank D. Korkosz.

STAMFORD: *Stamford Museum Planetarium.* Courtland Park, Stamford, Conn.

SCHEDULE: Sunday, 4:00 p.m. Special showings on request. Admission free. Spitz projector. Director, Ernest T. Luhde.

AMERICAN ASTRONOMERS REPORT

Here are highlights of some papers presented at the 86th meeting of the American Astronomical Society at Cleveland, Ohio, in December. Complete abstracts will appear in the *Astronomical Journal*.

Solar Flares and Solar 1.5-meter Radiation

The McMath-Hulbert Observatory of the University of Michigan and the Radio Astronomy Observatory of Cornell University, School of Electrical Engineering, have for several years conducted a co-operative program in which the goal has been the detailed comparison, hour by hour, of the solar radio radiation at wave length 1.5 meters

(frequency 200 megacycles) with solar activity observed photographically and visually. Different solar phenomena apparently influence the 1.5-meter records, but it is for solar flares that the relationships are most definite.

From the start of the Cornell radio records on August 28, 1948, until December 31, 1950, there were 141 flares for which the optical and radio data permitted definitive comparisons. The work was done by Drs. Helen W. Dod-

son and E. Ruth Hedeman, University of Michigan, and Dr. Leif Owren (on leave at Cornell from the Institute of Theoretical Astrophysics, University of Oslo). Based principally on flares for which complete McMath-Hulbert photographic records were available, the study was extended to include data reported by the International Astronomical Union and the Central Radio Propagation Laboratory of the National Bureau of Standards.

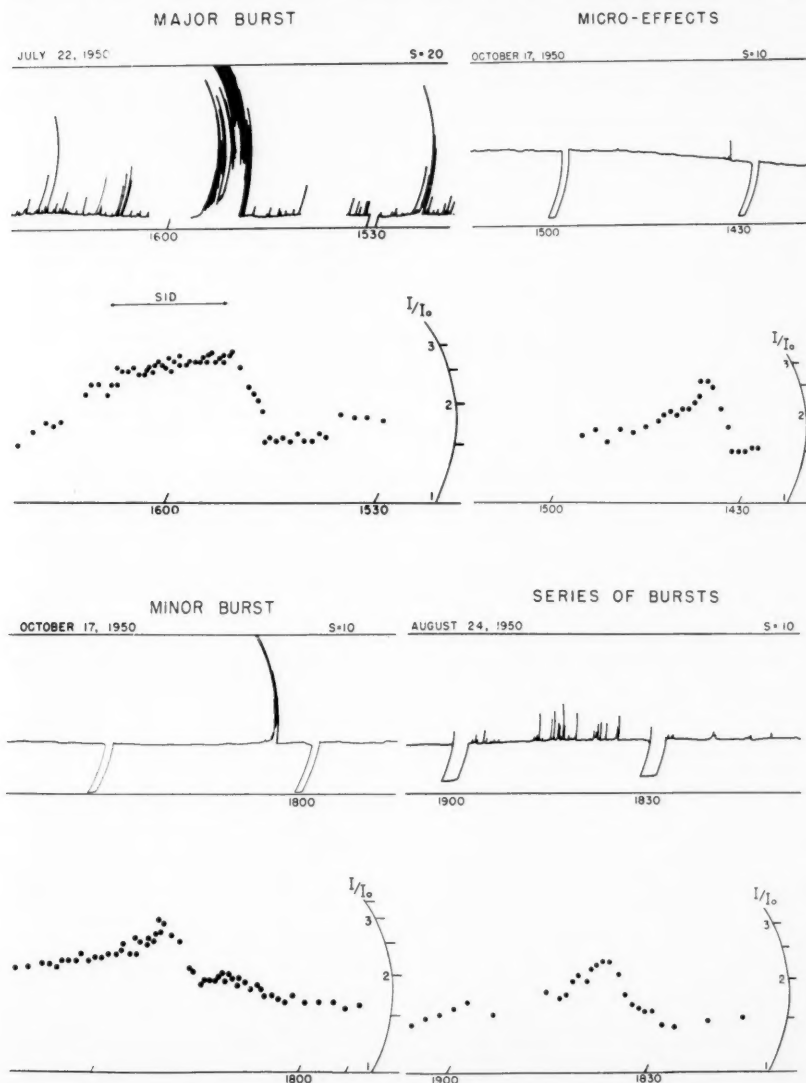
Solar flares are ordinarily observed in the light of the hydrogen-alpha line, but a flare is a complex phenomenon and the aspect of its activity that is related to the response at 1.5 meters is not certain. The complexity is indicated by the fact that in addition to the usually observed brightening in $H\alpha$ there may or may not be: (a) an ultraviolet component of sufficient intensity to cause a sudden ionospheric disturbance on the earth; (b) a spreading of a low-grade brightening to relatively distant parts of the plage area around the flare in the later stages of the flare; (c) active dark flocculi or surges seen in projection on the sun's disk; (d) the actual ejection of material particles.

The 1.5-meter solar radiation shows a wide range of changes in response to flare activity, which have been divided into seven groups. For these, the numbers in parentheses indicate the cases corresponding to the 141 flares for which correlation was sought:

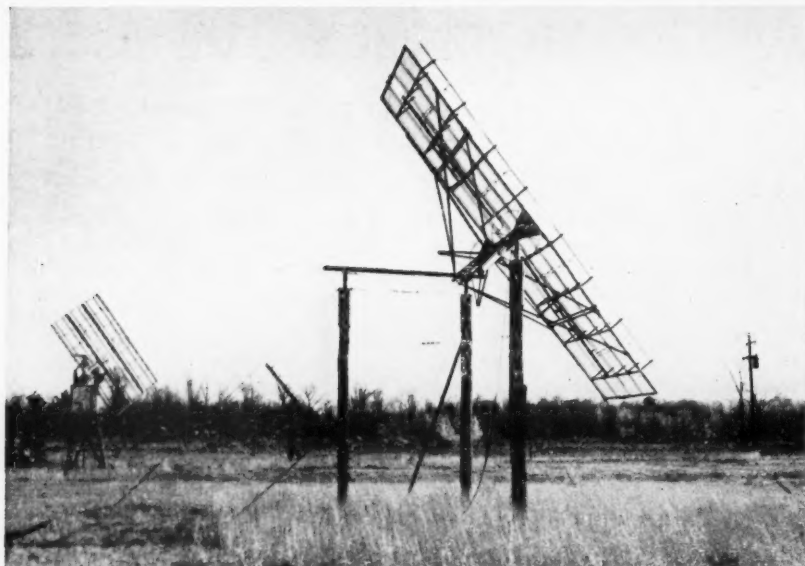
1. Major bursts, including outbursts (22)
2. Minor bursts (22)
3. Micro bursts (6)
4. Series of bursts (32)
5. Small rise in base level (4)
6. Noise storms (26)
7. Nulls (29)

Thus, 80 per cent of the flares produce some form of energy excess on the 1.5-meter records. For 25 of the 29 flares for which there was no distinctive radio response, the associated solar phenomena were relatively unimportant. For at least four cases, however, the flares were of considerable importance.

A study of 20 flares indicates that there is a direct relationship between the importance of the flare and the radio energy excess associated with it. The major, minor, and micro bursts tend to occur at the very commencement of the optical rise in brightness of the flare. The series of bursts begin before the observer detects the start of the flare in $H\alpha$ radiation. On the other hand, many of the noise storms and rises in



The characteristics of related solar radio noise and flare phenomena are illustrated here for four important types, with samples from the Cornell-McMath-Hulbert records. The radio record is in the upper part in each case, the relative flare intensity in the lower part. For the major burst of July 22, 1950, the visual flare intensity reached a relative value of 3 just as the 1.5-meter radiation increased enormously. In this instance there also occurred simultaneously a sudden ionospheric disturbance (SID) in the earth's atmosphere.



A view of the radio interferometer antenna system at the Cornell Radio Astronomy Observatory. One of the two broadside antennas is in the foreground, while the other is in the distance 76 meters away. At the left is the radio telescope, which may be driven to follow the sun in hour angle. Cornell University photograph.

base level have their onset at or near flare maximum. These delayed responses increase in intensity as the flare fades and often attain their greatest intensity just as the optical flare has subsided completely.

Cornell Radio Interferometer

The enhanced radiation of the sun at radio wave length 1.5 meters described in the preceding report could possibly be emitted either from localized areas of the sun or from the entire radio-emitting disk. It has not heretofore been possible to distinguish between these two

by the use of radio telescopes of currently used sizes because of their low resolving power. However, if bursts and increased base level originate in small, localized areas of the sun, it is possible to establish this fact by the use of interferometer techniques.

At the Cornell Radio Astronomy Observatory, a radio interferometer has been constructed by placing two broadside antennas 51 wave lengths apart on an east-west line. Two coaxial cables of identical electrical lengths feed the radiation intercepted by the antennas into a superheterodyne receiver. The polar diagram of the antenna system consists of a series of lobes in the horizontal plane which have an angular distance of about two solar diameters. Each lobe has a half-power beam width of 34 minutes of arc, comparable to the sun's angular diameter at 1.5 meters. The pointing accuracy so far attained is three to five minutes of arc.

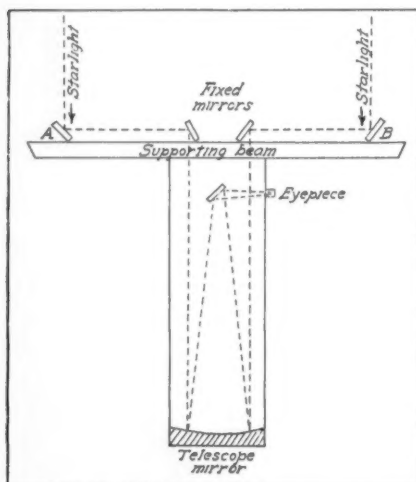
The radio interferometer represents a radio version of the Michelson stellar interferometer used for the measurement of stellar diameters and the angular separation of close double stars. The two broadside antennas correspond to the two outer mirrors in the five-mirror system of Michelson's Mount Wilson instrument. The coaxial cables may be said to correspond to the two beams of light being thrown inward to the main mirror via the two inner mirrors and brought to a common focus. In the Cornell interferometer, radio waves from a point source on the sun or from a radio star are intercepted by the two antennas and the signals mixed together at the input of the receiver. According

to the angle at which the radio waves are incident on the antennas, the two signals will interfere constructively or destructively with each other and cause a strengthening or weakening of the signal. Thus, as the point source under observation drifts across the antenna pattern, a wiggly line corresponding to Michelson's bright and dark fringes is traced out on the recording instrument.

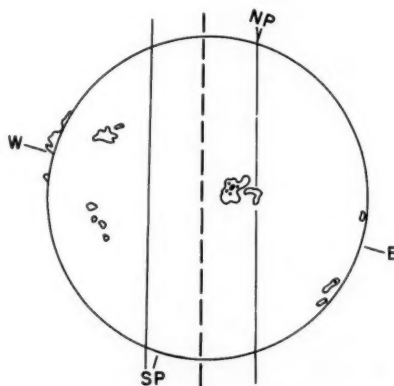
The observation consists of setting the antennas to the sun's upper transit altitude and recording the interference pattern as the sun drifts through the polar diagram around local noon. The usable daily observing time is about one hour. The determination of the position of a burst source also requires simultaneous observation of the sun with a radio telescope operating on the same frequency as the radio interferometer. The beam width of the 200-megacycle radio telescope is approximately 15 degrees or 30 times the angle subtended by the sun's disk. This shows the necessity of using the interferometer technique.

By comparison of the burst amplitudes on the radio interferometer and telescope records, the burst interference pattern can be separated out and its time relationship to the interference pattern of the quiet sun can be established. From this relationship, the source of the bursts can be located within a north-south strip which is generally between one fifth and one third the width of the sun's disk. The positions of enhanced base level sources can be found by a similar method.

Dr. Leif Owren, in presenting this paper, pointed out that the interferometer records are reduced without knowledge of the location of the active regions on the sun or of the positions of the solar flares at the times of observation.



The arrangement of the mirrors in one kind of astronomical interferometer, such as has been used on the 100-inch telescope at Mount Wilson Observatory in California.



AUGUST 15, 1950

OPTICAL DATA - MATH-HULBERT OBSERVATORY
RADIO DATA - CORNELL UNIVERSITY

An example of the manner in which the region of the sun's disk that is unusually active at 1.5 meters can be selected by means of the interferometer observations.

In collaboration with Dr. Helen W. Dodson, the 1950-51 observations with the radio interferometer have been compared with spectroheliograms of the sun. Two determinations of the positions of outbursts associated with solar flares have been made, and 14 determinations of the locations of burst sources. The enhanced 1.5-meter radiation was found to come from one or at most two localized regions on the sun, and not from the entire radio disk. The radio sources were in all cases associated with visually and photographically active regions of the sun.

The coincidence of the radio outbursts with optical flares in position as well as in time provides strong evidence for the association of the two phenomena. The first outburst took place on August 15, 1950. As the diagram shows, the interferometer placed the outburst source within a strip one third of a solar diameter wide centered on a line through the north and south points of the solar disk. The McMath-Hulbert Observatory spectroheliograms revealed a flare in a position falling well within the radio-determined strip.

The second outburst for which a position could be determined occurred on April 2, 1951. The coincidence in position between the optical flare and the source of the radio outburst was even more exact. The flare was observed near the western limb of the sun with a meridian distance of 74 degrees, exactly at the center of the strip designated by the interferometer as the source of the outburst.

The interferometer method proved its power to select the most active of several sunspot and plage areas on the sun. As illustrated here, during the period August 19-25, 1950, there were at least five such regions on the sun. The strip which the interferometer indicated as



Spectroheliograms taken at McMath-Hulbert Observatory during a period of solar activity in August, 1950. The center of the strip indicated as the source of radio bursts by the Cornell interferometer is plotted, and its close association with some of the active optical areas is evident during the six-day period, as the sun's rotation carried the region westward to the solar limb.

containing the 1.5-meter burst source included two of these regions. On successive days, the interferometer measurements followed these two regions as a rotation of the sun carried them westward across the disk. All five of the regions showed flare activity in this period, but 78 per cent of all the known flares occurred in the two regions selected by the interferometer. Also, the spots contained in the two plage areas were the largest spots on the disk and were those with the highest magnetic fields, 3,200 and 2,400 gauss, respectively.

The largest sunspot group in more than a year passed the central meridian of the sun on May 15-16, 1951. It was surrounded by a large and bright calcium plage in which more than 50 flares are known to have occurred in its passage across the disk. The green coronal line was intense over the region and the yellow line was observed also. On May 8th, before the spot itself had appeared on the disk, a portion of the attendant plage was visible and a great flare-type prominence (limb flare) occurred at the sun's east limb, as shown in the

diagram. There were no other regions of any significance on the sun at the time. The diagram shows how the interferometer observations followed this active region across the sun.

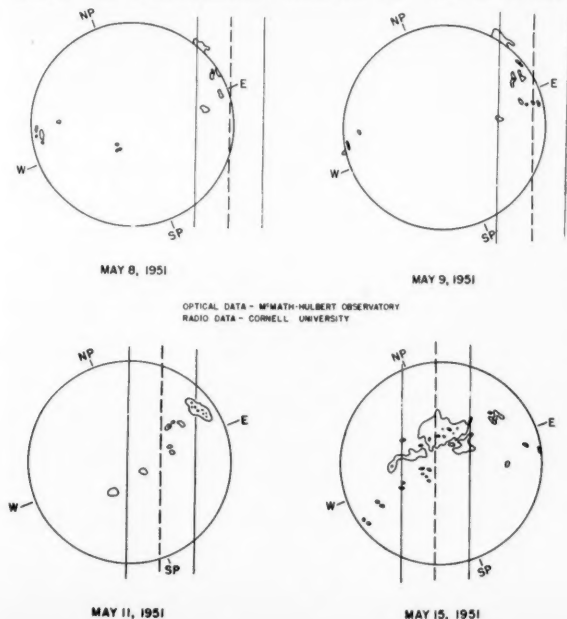
COMET PONS-BROOKS

Dr. Paul Herget, director of the Cincinnati Observatory, has announced the expected return of Comet Pons-Brooks 1884 I. It should be picked up in large telescopes any time in the near future, in the constellation of Lyra, probably at 18th magnitude. The brightness will slowly increase, to about 17.6 by September 15th. Harvard Announcement Card 1166, dated February 25th, carried a search ephemeris (continued on Card 1170) and reads in part:

"A solution from observations in 1812 and 1883-84, with accurate special perturbations, yields the period with a probable error of only two minutes of time... Perihelion passage will be 1954 May 27, but the earth is then situated in the most unfavorable position, and the maximum brightness will be about fifth magnitude."

This comet was discovered originally in 1812 by Jean Louis Pons, who found 27 comets in his lifetime. At its 1883 return, when it was rediscovered by W. R. Brooks, it developed a tail eight degrees long and was a naked-eye object for three months. The period is a few years less than that of Halley's comet.

Comet Pons-Brooks is of considerable scientific interest. It varies in brightness erratically and in an unexplained manner. There is some slight evidence of deviation from its orbit as if it were subjected to non-gravitational forces, such as those proposed by the Whipple comet theory. If the comet can be observed adequately for two years before and after perihelion, there may then be valuable observational support for the Whipple theory, that comets are composed of ices (and embedded meteoric matter) which evaporate under the influence of solar radiation when they are sufficiently near the sun.



Another example of the close correlation of solar radio and optical phenomena is illustrated for an eight-day period in 1951. Here the interferometer revealed the solar limb as active, where a prominence was observed before the associated spot became visible.

The 71st...

Spitz Planetarium

is being installed at
**THE CLEVELAND MUSEUM
OF NATURAL HISTORY**
Cleveland, Ohio

SPITZ LABORATORIES, INC.

5813 Woodland Avenue
Philadelphia 43, Pa.

SKY-SCOPE

The new and improved 3½-inch
Astronomical Telescope that
amateurs everywhere are
talking about.

Completely Assembled—\$29.75
Equatorially Mounted, 60 Power
¼-wave Aluminized Mirror
Ramsden Type Ocular

125x & 35x Supp. Eyepieces, ea. \$5.00
6-power Finders postpaid, ea. \$7.00

We invite your attention to our free brochure describing in a straightforward manner the instrument's amazing performance.

THE SKYSCOPE CO., INC.

475-a Fifth Avenue, New York 17, N. Y.

RAIN GAGE

No. 510 Direct-reading gage fits
on any fence post. Capacity,
six inches. Overall length 13
inches. Mounting bracket. \$4.95

*Send for our complete catalog of amateur
and Weather Bureau instruments.*

SCIENCE ASSOCIATES

401 N. Broad St., Phila. 8, Pa.

Splendors of the Sky

Third Edition — 1951

Here is a completely revised and
up-to-the-minute edition of this
popular astronomical picture book.
Its simple but comprehensive captions
provide a beginner's course
in astronomy. Printed on heavy
coated paper, 8½ by 11½ inches.

50 cents a copy, postpaid,
coin and stamps accepted

SKY PUBLISHING CORPORATION
Harvard Observatory, Cambridge 38, Mass.

Amateur Astronomers

WESTERN CONVENTION

The fourth annual convention of western amateur astronomers will be held August 18th to 20th at the University of California, Berkeley, with the Eastbay Astronomical Society as host.

Leuschner Observatory will be the site of the meeting, and Dr. Otto Struve, chairman of the department of astronomy, will deliver the chief address. Exhibits, with awards for the most notable homemade instruments, a star party, and visits to local astronomical points of interest will be on the program. The banquet is scheduled for the evening of August 18th. W. C. Marion, president of the Eastbay society, is in charge of convention plans. Miss H. E. Neall is secretary of the convention committee, and anyone interested in participating should communicate with her at 1626 Chestnut St., Berkeley 2, Calif. The committee is grateful that the Astronomical Society of the Pacific is aiding in all plans.

FRANK KETTLEWELL
325 El Cerrito Ave.
Piedmont 11, Calif.

NOTES FROM HERE AND THERE

Utica, N. Y. A device for accurately observing features of the northern lights, constructed by Bernard L. Plante, president of the Utica Amateur Astronomers, consists of a sighting groove, V-shaped in wood, in which a pair of binoculars or a low-power telescope can be mounted. This sight is attached to a vertical disk that is marked in degrees for measuring altitude, and is mounted on a horizontal plate for measuring azimuth. There is a three-point adjustment for horizontal leveling. The total cost of the instrument was about \$37. It is now being used by Edward Bryant, Cassville, N. Y., who is recording aurorae in co-operation with Donald S. Kimball, Yale University Observatory.

Pittsburgh, Pa. According to the *Star-gazer*, bulletin of the Amateur Astronomers Association of Pittsburgh, the director of Allegheny Observatory, Dr. N. E. Wagman, has lent the society an 18-inch flat mirror to test Cassegrainian mirrors and other optical surfaces made by members of the group. The flat is currently appraised at \$10,000, and will be used only under the supervision of the telescope makers' shop superintendent, Leo N. Schoenig.

Worcester, Mass. The Aldrich Astronomy Club is constructing an observatory in Holden, Mass., to be equipped with a 9½-inch reflector and a proposed Schmidt camera. Smaller cameras and another 6-inch reflector will probably also be available. Most of the work will be done by members in their spare time, but a minimum expenditure of \$1,200 is necessary for materials and equipment. Of this amount, \$200 has already been set aside, the members expect to contribute another \$200, and the remainder will be obtained from public subscription to what is to function as a community observatory.

Key West, Fla. The southernmost astronomy group in the United States, the Key West Astronomy Club, has the

pleasure of observing the Southern Cross these days. J. P. Baillod, president, states in his monthly bulletin: "The Southern Cross will be visible in the evening sky, 3 minutes 56 seconds earlier every night until mid-June, when its light will be lost in the twilight. The best time to look is when it crosses the meridian. It is then due south with the lower star, Acrux, 2° 48' above the horizon. The whole constellation can be seen about 45 minutes before, and 45 minutes after transit, while the three upper stars are visible several hours."

THIS MONTH'S MEETINGS

Buffalo, N. Y.: Amateur Telescope Makers and Observers, 8 p.m., Museum of Science. May 7, Rev. George Walker, "Calendars."

Cambridge, Mass.: Bond Astronomical Club, 8 p.m., Harvard Observatory. May 1, election of officers, short papers by members, motion pictures on high-altitude research and rocketry.

Cleveland, Ohio: Cleveland Astronomical Society, 8 p.m., Warner and Swasey Observatory. May 16, Dr. J. J. Nassau, Warner and Swasey Observatory, "Our System of Stars."

Dallas, Tex.: Texas Astronomical Society, 8 p.m., First National Bank. May 26, E. M. Brewer, "Astronomy for Fun."

Greensboro, N. C.: Greensboro Astronomy Club, 8 p.m., Science Building, Woman's College. May 14, Kenneth Shepherd, Forsyth Astronomy Club, "The Planets."

Indianapolis, Ind.: Indiana Astronomical Society, 2:30 p.m., Riley Library. May 4, Dr. Frank K. Edmondson, Indiana University, "Mars."

Lorain, Ohio: Black River Astronomical Society, Lorain-Elyria, 8 p.m., Lorain YMCA. May 13, William A. Mason, "Applying Kepler's and Newton's Laws."

Los Angeles, Calif.: Los Angeles Astronomical Society, 7:45 p.m., Griffith Observatory. May 13, Dr. Robert G. Harrington, Mount Palomar Observatory, "The 48-inch Schmidt Sky Survey."

Madison, Wis.: Madison Astronomical Society, 8 p.m., Washburn Observatory. May 14, Dr. C. M. Huffer, Washburn Observatory, "Stream-of-Gas Stars."

Minneapolis, Minn.: Minneapolis Astronomy Club, May 7, 7:30 p.m., Library Science Museum, Maxine Begin, planetarium program. May 21, picnic at Glenwood Park, field trip.

New York, N. Y.: Amateur Astronomers Association. May 10, 25th anniversary dinner, Hotel Alden. May 21, 8 p.m., American Museum of Natural History, annual meeting.

Pittsburgh, Pa.: Amateur Astronomers Association, 8 p.m., Buhl Planetarium. May 9, D. F. Mathe and Joseph Racuba.

Rochester, N. Y.: Rochester Astronomical Society, 8 p.m., Rochester Museum. May 6, Dr. Bart J. Bok, Harvard Observatory, "The Center of Our Galaxy."

Rutherford, N. J.: Astronomical Society of Rutherford, 8 p.m., YMCA. May 1, "Exploding Astronomical Fallacies."

BOOKS AND THE SKY

THE PLANET MARS

Gerard de Vaucouleurs (translated by P. A. Moore). Faber & Faber, Ltd., London, 1951. 91 pages. 10s 6d. Published in the United States by the Macmillan Company, New York, 1951. \$2.00.

THE REVISIONS introduced in the second edition of *The Planet Mars* are limited to an occasional new paragraph or word; but each change is an improvement. In our review (August, 1950) of the first edition, a few errors were noted; these have all been corrected. The book is written in a light and charming style, with a point of view nowhere extreme. On controversial issues both sides are presented, though this means, of course, that in such cases no clear conclusion is reached.

Since the contents are essentially the same as in the first edition, only a few supplementary remarks are made here. The problem of atmospheric composition is well treated, but the reviewer would slightly differ with the arrangement in Fig. 2, page 44, where he would put the "blue clouds" and the "violet layer" coincident, with the stratosphere beginning at about 16 kilometers. The author of the book leaves open the nature of Mars' violet haze layer, since shown to be composed of ice crystals about 1/3 micron in diameter. The treatment of atmospheric transmission (page 55) is perhaps too brief and not quite clear. Solar radiation longer than 2000 angstroms will be scattered but not absorbed by the haze layer and will reach the Martian surface, unless an absorbing agent not yet identified (like small quantities of ozone) is present. The temperature measures quoted are too high, as was shown by a new reduction by Adel (1949). The vegetation hypothesis is presented with less enthusiasm than one might have expected.

The above comments hardly detract from the general usefulness of de Vaucouleurs' book as a reliable and very readable introduction to the Mars problem. It is warmly recommended to all readers.

GERARD P. KUIPER
Yerkes Observatory

PHYSIQUE DE LA PLANETE MARS

Gerard de Vaucouleurs. Editions Albin Michel, 22 Rue Huyghens, Paris 14e, France, 1951. 420 pages. 825 fr.

THIS SECOND BOOK (in French) may be regarded as the documentation for the contents of the smaller book, reviewed above.

Because of its more technical nature

INDEXES AND BACK ISSUES

of *Sky and Telescope* are available. For Volumes I through IX, indexes are 35 cents each postpaid. For Volume X and future volumes, the index is included without charge in the October issue each year. For back issues, let us know your needs and we shall try to fill them.

SKY PUBLISHING CORPORATION

(and possibly because of the language barrier), fewer readers may have the interest and perseverance to study this book. But those who do will be repaid by an improved appreciation of the labors of planetary astronomers whose basic data are obtained with such difficulty. The book is strongly recommended to all those who wish to make a serious study of the Martian problem.

G. P. K.

ASTRONOMY OF STELLAR ENERGY AND DECAY

Martin Johnson. Dover Publications, Inc., New York, 1951. 216 pages. \$3.50.

DR. JOHNSON has attempted, as others have done before him, to write a book of astronomical interest which will be useful both to the amateur astronomer and layman, and to the student who is beginning a serious study of the science.

The book is divided into two sections; in the first part the astrophysical topics are treated in a qualitative way, without, however, impairing the clarity of expression; in the second part the bases of the reasoning leading to the conclusions discussed earlier are given, and are discussed in a more quantitative manner. The mathematics used is quite elementary.

The subject is the "natural history of a star." In Part I under this main heading are discussed the steady state of a star, its luminosity, surface temperature, mass and size, and the source of energy and state of matter. Then comes a chapter on the spectral classification of stars, and its bearing on the problem of stellar evolution. Dr. Johnson next gives a summary of the various modes of departure of stars from equilibrium conditions. Here he includes pulsating stars, erupting stars and planetary nebulae, novae, supernovae, and peculiar erupting stars. In the final chapter of this section he discusses the advances that have been made in the theoretical field. Among others, he describes some of the major contributions made by Milne, Chandrasekhar, Cowling, Bethe, and Hoyle.

The second part opens with some description of the experimental techniques involved in the measurement of luminosity relations. Following this comes a series of short chapters, each attempting to introduce briefly the fundamental relationships which link together the steps in the argument advanced in Part I. Examples of chapter headings are: "Atomic sources of energy," "The Cepheid problem," "The mass luminosity law," and "Stability criteria for a star's life."

In choosing as his subject the natural history of a star, and in specifically not considering the problem of stellar evolution from an initial state before the star is formed, that is, by starting with a star in a steady state, Dr. Johnson has remained on firm and orthodox ground. The book was originally written in 1948 and published in England in 1950. Had it been more recently written, it would have been of interest if something had been said of the speculations of von Weizsäcker

er and others concerning the evolutionary process.

The account is written in an unhappy style, which is presumably a compromise between technical and popular scientific writing. In conclusion, it is fair to say that Dr. Johnson has succeeded in his object, and the book can be recommended to both layman and student.

GEOFFREY BURBIDGE
Harvard College Observatory

SKY PUBLICATIONS

SKY SETS — I

Pictures of solar system and galactic objects, 24 in the set, printed on heavy white paper, and suitable for study and framing. Ready soon the set, \$3.50

MAPPA COELESTIS NOVA

The northern sky to -45° is shown in this large chart, and each star is colored according to its spectral class. The chart makes a fine transparency, 28 inches square. \$4.00

SKALNATE PLESO ATLAS OF THE HEAVENS

Sixteen charts cover the entire sky to magnitude 7.75; 1950 co-ordinates. Each chart area is $16\frac{1}{2}$ by $23\frac{1}{2}$ inches. \$5.50

MOON SETS

Eighteen pictures, nine at first quarter and nine for the last quarter, each on a sheet of heavy stock 12 by 18 inches. There are key charts for named lunar features. \$2.50

Making Your Own Telescope
— Allyn J. Thompson \$3.50
World Wide Planisphere
— William H. Barton, Jr. \$3.00
Splendors of the Sky 50 cents

SKY PUBLISHING CORPORATION
Harvard Observatory, Cambridge 38, Mass.

IMPORTANT NOTICE

Due to increased costs (even postage rates) an increase in prices is necessary on charts and slides on September 1st. This notice, well in advance, gives you the opportunity to buy now and save. We came to this decision reluctantly. We dislike inflation, but want to continue our service. Buy now before forced inflation invades.

We are at your service with two sets of charts (25 charts to a set), and two sets of 35-mm. slides (24 slides to a set).

2 slide sets and 2 chart sets	\$22.00
2 slide sets and 1 chart set	\$19.25
1 slide set and 2 chart sets	\$13.75
1 slide set and 1 chart set	\$11.00
2 slide sets \$16.50; 1 slide set ..	\$ 8.50
2 chart sets ... \$ 5.75; 1 chart set ..	\$ 3.00

Circular? Drop us a card.

ASTRONOMY CHARTED

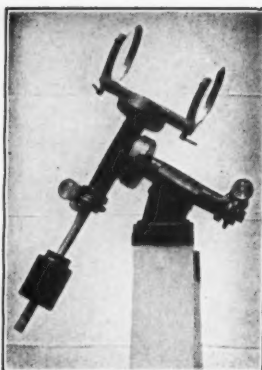
33 Winfield St., Worcester 2, Mass., U.S.A.

The British Astronomical Association

Founded 1890, now 2,000 members
Open to all interested in astronomy

Chief objects are mutual assistance in observation, and circulation of astronomical information. Publications: *Journal*, about 8 times yearly; *Annual Handbook*; *Circulars* giving astronomical news; *Memoirs of the Sections* (Sun, Moon, Planets, Comets, Aurorae, Meteors, Variable Stars).

For further particulars write
The Assistant Secretary, B.A.A.
303 Bath Rd., Hounslow West,
Middlesex, England



Amateur Telescope Makers Supplies

Ramsden Eyepieces
Combination Eyepiece and Prism Holders
Mirror Cells
Finders
Equatorial Mountings
Prisms

Send for a price list

C. C. Young 25 Richard Road
East Hartford 8, Conn.

BERAL COATINGS

Have the same optical characteristics as aluminized coatings, but mechanically they are far more durable. Prices for BERAL coating telescope mirrors are as follows: 6" diam.-\$2.50; 8"-\$3.50; 10"-\$5.00; 12 1/2"-\$8.00; each f.o.b. Skokie, Ill.

ORTHOSCOPIC EYEPIECES of the highest quality, 5/8" f.l. and 1 1/4" o.d. Price \$9.50 postpaid.

ACHROMATIC OBJECTIVES in oxidized brass cells, clear aperture 1-9/16" and 1 1/2" f.l. Ideal for use in making small scopes and finders. They may be used with 1/4" f.l. eyepieces giving 42 times magnification, with excellent results. Price \$5.00 each postpaid.

PITCH POLISHED DIAGONALS 1-3/8" x 1-7/8" x 3/8". Excellent for use with 6" mirrors and with F:8 to F:10 8" mirrors. Price, flat to 1/2 wave, \$2.75 each; flat to 1/4 wave, \$3.75 each; flat to 1/10 wave, \$5.25 each; all postpaid.

LEROY M. E. CLAUSING
8038 MONTICELLO AVE. SKOKIE, ILL.

NEW BOOKS RECEIVED

PALOMAR OBSERVATORY, *Alter and Clemshaw*, 1952, *Griffith Observatory*. 76 pages. 90c.

A profusely illustrated paper-bound compilation that includes the dedication addresses at Palomar, a technical discussion of the principles of the Schmidt camera, and photographs of celestial objects taken with the Hale and 48-inch Schmidt telescopes.

THE SCIENCES IN NAVIGATION, various authors, 1951, *Institute of Navigation*, University of California, Los Angeles 24, Calif. 96 pages. \$1.00 paper bound.

Papers given at the symposium on "The Sciences in Navigation" at the June, 1951, meeting of the Institute of Navigation are here collected in a paper-bound volume. Following an introduction, there are 13 papers, among whose titles are Physics in Navigation, Optics in Navigation, Mathematics in Navigation, Astronomy in Navigation, Meteorology in Navigation, Psychology in Navigation.

DIALOGUES CONCERNING TWO NEW SCIENCES, *Galileo Galilei*, reissue undated, *Dover*. 300 pages. \$1.50 paper bound.

This translation by Henry Crew and Alfonso de Salvio of Galileo's 1638 work was published in 1914 by Macmillan, and is here reissued in an inexpensive paper-bound edition. The full title in translation is, "Discourses and Mathematical Demonstrations concerning Two New Sciences pertaining to Mechanics and Local Motions."

RADIO ASTRONOMY, *Lovell and Clegg*, 1952, *Chapman and Hall, Ltd.*, 37 Essex St., London W. C. 2. 238 pages. 16s.

The two authors, closely associated with the development of the new science of radio astronomy, discuss the subject particularly in relation to astronomy and astrophysics. They have tried "to make the book readable to as wide a circle as possible."

MATTER AND MOTION, *James Clerk Maxwell*, undated, *Dover*. 163 pages. \$2.50 cloth; \$1.25 paper.

This book on the principles of dynamics, which first appeared in 1877, is here reissued from a volume edited by Sir Joseph Larmor. A note by the editor prefacing the book states: "...as a reasoned conspectus of the Newtonian dynamics, generalizing gradually from simple particles of matter to physical systems which are beyond complete analysis, drawn up by one of the masters of the science, with many interesting side-lights, [the book] must retain its power of suggestion even though parts of the vector exposition may now seem somewhat abstract."

LES ATMOSPHERES STELLAIRES, *Daniel Barbier*, 1952, *Flammarion et Cie*, 26 Rue Racine, Paris VIe. 238 pages. 625 fr. paper bound.

Although hardly a popular account, with its use of calculus, the book, in French, covers the physics of stellar atmospheres in a fairly simple and descriptive manner.

THE EXACT SCIENCES IN ANTIQUITY, *O. Neugebauer*, 1952, *Princeton University Press*. 191 pages. \$5.00.

Recent investigations on Babylonian mathematics and the interrelations of Greek, Mesopotamian, and Hindu scientific culture are discussed here. Much of the material deals directly with astronomy.

THE ASTRONOMICAL UNIVERSE, *Wasley S. Krogdahl*, 1952, *Macmillan*. 599 pages and maps. \$6.25.

A new book designed as an introductory text for college astronomy, with numerous illustrations and diagrams. Sections are on the solar system, the anatomy of a star, the stellar population, the organization of the universe, the evolution of the universe. There is an extensive list of questions following each chapter.

At Last! — A Telescope You Can Afford!



2.4-INCH EQUATORIAL UNITRON Model 128

The complete instrument for the active amateur.

Objective: 60-mm. (2.4") aperture, 900-mm. (35.4") focal length, f/15.

Eyepieces: 9 mm.achr. Ramsden for 100x
1 1/2 mm. Huygens for 50x
15x orthoscopic, 128x, and 72x eyepieces available at extra cost.

COMPLETE with equatorial mounting and slow-motion controls, tripod, view finder, star diagonal, erecting prism system, sun-glass, wooden case. **Only \$225**

UNITRON Refractors at Unbelievably Low Prices

The telescopes all astronomers are talking about. Precision made from the finest materials by one of the world's largest manufacturers of optical instruments.

—LENSES are FULLY CORRECTED for spherical and chromatic aberration and are COATED for maximum brilliance and clarity of image.

—Each model is equipped with a sturdy TRIPOD and SLOW-MOTION mechanism, low-power VIEW FINDER, STAR DIAGONAL for convenience in observing at all altitudes, RACK AND PINION FOCUSING, EYEPIECES, a sunglass for solar observation, an ERECTING PRISM SYSTEM for terrestrial observation, and comes complete with WOODEN CARRYING CASE.

—These accessories are included with your telescope. . . . There are no costly extras to buy.

—There are models as low as \$75.

2.4-INCH ALTAZIMUTH REFRACTOR UNITRON Model 114

Not illustrated. Identical with Model 128 but with altazimuth instead of equatorial mounting. Same accessories included. **Only \$125**

Send check or money order or write today for further information to

UNITED TRADING CO.

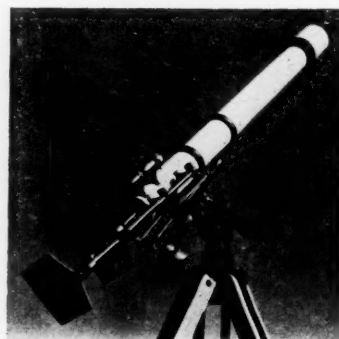
204 Milk St., Dept. T-4, Boston 9, Mass.

Fully Guaranteed

Telescopes Shipped Express Collect
25% deposit required on C.O.D. shipments

TELESCOPES MICROSCOPES
SCIENTIFIC INSTRUMENTS

Coming Soon!



3-INCH EQUATORIAL UNITRON Model 142

Ideal for amateur research and school observatories.

Objective: 75-mm. (3") aperture, 1200-mm. (47.2") focal length, f/16.

Eyepieces: 6 mm. orthoscopic for 200x
9 mm.achr. Ramsden for 133x
12.5 mm. Huygens for 96x
18 mm. Huygens for 67x

COMPLETE with equatorial mounting and slow-motion controls, tripod, setting circles, sun projecting screen, view finder, star diagonal, erecting prism system, wooden case.

Write for preliminary announcement.

GLEANINGS FOR ATM's

EDITED BY EARLE B. BROWN

A LIGHTWEIGHT PORTABLE FOR GROUP OBSERVING

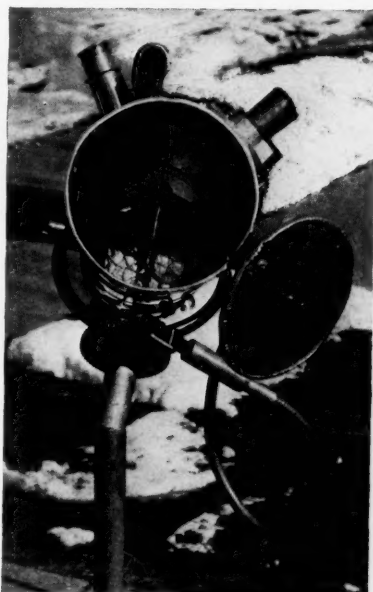
MY EARLY EXPERIENCE in pursuit of the hobby of astronomy was under the influence of professional men who usually believe that an instrument, whether professional or amateur, requires heavy construction embedded in concrete to prevent vibration when in use. After devoting several years, and some cash, to experimenting with heavy gas pipes and a strong mixture of concrete, I decided to construct an instrument of light weight that could be carried about by hand with little inconvenience. It is a 6-inch reflector.

The first instrument, with base, weighed more than a ton, and was entirely free of vibration. The one pictured here weighs about 40 pounds; there is very little vibration as long as we can keep the hands of the observers off the instrument. This is a hand-made reflector, but has been enjoyed by multitudes of people who come to look through and not at it.

Much of the machine work was done by Prof. John Anderson, of Hazelcrest, Ill. He is a manual training teacher, a master mechanic, and an artisan who enjoys helping youngsters in the pursuit of their hobbies. Large groups of school children, scouts, high school and college students request opportunities to observe with this instrument, and their enthusiasm for this free service is very great.

The length of the tube, when assembled, is 48 inches. Each section is approximately 28 inches, thus allowing eight inches for telescoping one section into the other. A 6-inch mirror requires an 8-inch tube, allowing one inch all-around clearance for the adjustment screw clamps which hold the mirror in its seat. The distance from the face of the mirror to the prism center measures 43 inches. From the prism to the outer end of the eyepiece is approximately six inches, 49 inches in all, with freedom for adjustment with rack and pinion if one is available. However, I use close-fitting tubes for eyepiece focus adjustment.

The instrument is equipped with twin eyepieces, at 90 degrees to each other. The observer may thus switch from high power to low power with no loss of time. Then,



The rebuilt 6-inch reflector, showing the two eyepiece holders, the hinged cover, and the slow-motion control by flexible cable. Photo by Hubert Pauley.

too, this gives the observer a choice of positions, which is often a relief to the neck muscles.

The short section of the brass tube which holds the mirror in its seat is tight-fitting into the brass extension of the aluminum tube and is screwed into position by $\frac{1}{4}$ " set screws. It can be disconnected in a few seconds. I hinged a circular shutter at the upper end of the tube to protect the mirror from injury when the instrument is not in use.

The simple mechanism of the worm screw and flexible shaft, which are used to drive the telescope by hand, and the horse-shoe working off the polar axis, are plainly visible in the accompanying illustration. The instrument is made almost entirely of aluminum and brass. The wood-



The aluminum case in which the telescope is packed for carrying. The instrument can be assembled or taken apart in three minutes. Photo by Hubert Pauley.

UNUSUAL OPTICAL BARGAINS

Your Chance to Own a Truly Fine Precision Instrument

IMPORTED 200 POWER MICROSCOPE

PERFORMANCE EQUALS
\$50 to \$75 INSTRUMENT

Amazing optical qualities, fine focusing, superb definition, clarity! Serviceable construction . . . the greatest microscope bargain on the market!

Try it for 10 days . . . if you are not completely satisfied, your money refunded in full. Hdw. case included, no extra cost.

Stock #70,000-Y . \$12.50 Postpaid



ONLY
\$12.50
Postpaid

1 ocular, 1 objective lens, chromatic type adjustment. Rack & pinion focusing. Revolving disc-light adjustable mirror.

Inclined Eyepiece 300 POWER

IMPORTED MICROSCOPE

A TERRIFIC VALUE!

ONLY \$22.50 1 ocular, 1 objective lens (will take any standard eyepiece or objective). Prismatic revolving turret eyepiece, disc-light adjustable mirror; handy focusing. Finest precision construction throughout! Hdw. case included. 10-day refund privilege.

Stock #70,001-Y . \$22.50 Postpaid



Full Grown Performance in a Useful 80 Power

IMPORTED BABY MICROSCOPE

ONLY 5" HIGH!

Students, beginners, or full-fledged lab-men will find plenty of use for this little gem. Easily carried. Make minute inspections: plant and animal life, materials, metals, etc. — it gives astounding, sharp definition! Good optical qualities, hinged base for inclined, easy viewing, easy-to-use pinion focusing. Circular stage, revolving disc-light adjustable mirror. A real buy! 10-day refund privilege.

Stock #50,000-Y . \$4.00 Postpaid



JUST
\$4.00
Postpaid!



BARGAINS! IMPORTED PRISM BINOCULARS

Save 50% and More!
Fully Guaranteed!

30 DAY FREE TRIAL! Luxury features include coated optics, achromatic lenses; leather case included at no extra cost. Examine, test a pair yourself!

Stock #	Model	Postpd. Price*
1507-Y	6 x 30	\$39.50
1510-Y	7 x 35	45.50
1523-Y	7 x 50 (Not coated)	36.00
1521-Y	16 x 50	72.00

*Prices shown, Individual Focus — For Central Focus add \$4 addtl. to above prices. *All prices subject 20% Federal Excise Tax

TELESCOPE EYEPIECE — Consists of 2 Achromatic lenses F.L. 28 mm. in a metal mount. Stock #5140-Y . \$4.50 Postpaid

LENS CLEANING TISSUE — First quality, sheet size 11" x 7 1/2". Made to Gov't specifications. Stock #721-Y . . . 500 sheets . . . \$1.00 Postpaid

SIMPLE LENS KITS! — Fun for adults! Fun for children! Kits include plainly written illustrated booklet showing how you can build lots of optical items. Use these lenses in experimental optics, building TELESCOPES, low power Microscopes, etc.

Stock #2-Y—10 lenses . . . \$1.00 Postpaid
Stock #5-Y—45 lenses . . . \$5.00 Postpaid
Stock #10-Y—80 lenses . . . \$10.00 Postpaid

We Have Literally Millions of WAR SURPLUS LENSES AND PRISMS FOR SALE AT BARGAIN PRICES. Write for Catalog "Y"—FREE!

Order by Stock No. — Send Check or M.O.
Satisfaction Guaranteed

EDMUND SCIENTIFIC CORP.
BARRINGTON, NEW JERSEY

New Low Prices on PYREX Reflecting Telescope Kits

The most complete kits
on the market.

In addition to the usual supply of abrasives, rouge, etc., you get the new, fast-polishing cerium oxide to save hours of work.

You can get a brass diagonal holder (spider) for only \$1.00 additional if ordered with a telescope kit. Prices quoted below are for a Genuine Pyrex telescope blank and a plate glass tool.

PYREX MIRROR KITS

Diameter	Thickness	Price
4 1/4"	3/4"	\$ 5.50
6"	1"	\$ 7.25
8"	1 1/2"	\$10.50
10"	1 3/4"	\$17.50
12 1/2"	2 1/8"	\$33.00

Two circle dials with every Pyrex Kit.
4" to 16" PYREX CARRIED IN STOCK

PLATE GLASS KITS

6"	1"	\$ 5.50
7"	1"	\$ 6.75
8"	1"	\$ 8.00

Postage Paid to 1st and 2nd postal zones from N. Y. Add 5% 3rd and 4th zones, 10% 5th and 6th zones. Add 15% 7th and 8th zones.

Parabolic pyrex mirrors made to order.

Send for free catalog of optical supplies.

DAVID WILLIAM WOLF

74 Hunnewell Ave. Elmont, L. I., N. Y.

en parts and metal pipes are aluminum painted, which makes the assembly quite presentable.

With Ft. Dodge and Dodge City, Kans., only four miles apart, it is our hope to organize an amateur society in this area. I am chaplain of the Kansas Soldiers' Home at Ft. Dodge. It was partly to bring the stars to members of the home who were unable to get out and walk to the park where the original instrument was set up that this lightweight instrument was designed.

FRANK L. ROSE

Kansas Soldiers' Home
Ft. Dodge, Kans.

STOPS FOR SOLAR OBSERVING

FOR OBSERVING the sun with a reflector, I have found that an aperture stop inserted about a foot behind the objective gives me the best results. The diameter of the circular opening depends, of course, on the magnification used, and care must be taken in determining the proper size: Start with too small an aperture, to avoid blinding the eye, gradually widening it to the aperture of best seeing for the magnification used.

When the aperture stop is placed in front of the objective, the latter is heated unequally and its definition suffers. And even a Herschelian wedge heats up, resulting in a bulge of its surface sufficient to show gradual blurring when the sun's image is projected a maximum distance behind the eyepiece. The wedge itself is unequally heated by the converging beam,

which leaves the rectangular corners unheated.

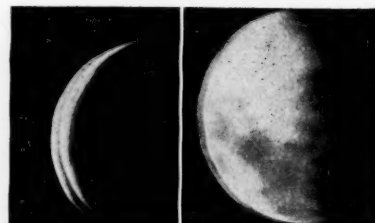
For observing the sun with a reflector, the mask can be placed at the open end of the tube, its aperture a little wider than the occlusion of the Newtonian diagonal. While this has the disadvantage of unequal heating of the primary mirror, I find it better than other devices to deflect or to screen off most of the light near the focal point's extreme heat. Another way is to place the right-sized stop about two inches in front of the Newtonian diagonal, but this stop should not cut off any more light than the diagonal support itself. Thus, the primary mirror is equally heated by the sun, excepting the central diagonal area; the heat to the Newtonian diagonal is greatly reduced by the stop just ahead of it. Nevertheless, for a reflector the first method, a mask at the tube opening, is simpler, and I consider it better.

FRANK L. GOODWIN

345 Belden Ave.
Chicago 14, Ill.

MOTION IN LUNAR PHOTOGRAPHS

EXPERIMENTS with photographing the moon through the eyepiece of a telescope indicate the need for really short exposures or a clock drive if sharp pictures are to be obtained. To illustrate this, I enclose two prints of double ex-



Double exposures of the moon, taken through the eyepiece of a 6-inch telescope with a camera mounted on a tripod, in the manner described by Allyn J. Thompson in this department for February, 1952.

posures, one of the crescent moon with about six seconds of time between shots, the other of a gibbous moon with about four seconds between images. Each exposure was itself about half a second long, which is obviously too great if the lesson of the double exposures is to be heeded. In one second of time, the sum of the moon's orbital motion and its apparent motion due to the earth's rotation is about 15 seconds of arc, roughly 20 times the resolving power of a 6-inch mirror.

ALLYN J. THOMPSON

1628 Mayflower Ave.
New York 61, N. Y.

MAY METEORS

The Eta Aquarid meteor shower is at maximum about May 4th. Rates of 10 meteors per hour may be expected preceding dawn, when the moon will be setting.

E. O.

ORTHOSCOPIC OCULARS

WE HAVE IN STOCK for immediate delivery the best eyepiece ever produced for astronomical and scientific work, with the following characteristics:

1. Four-element design giving a flat, beautifully corrected field of 50° covering more than 160 per cent of the area of the conventional Ramsden for the same power. This eyepiece is a "must" for RFT work.
2. Precision optical elements, magnesium fluoride hard coated, increasing the light transmission approximately 10 per cent.
3. Simple take-down for cleaning.
4. Precision metal parts black anodized for anti-reflection and ground to 1 1/4" O. D.
5. Clean mechanical design permitting comfortable observation and ease of focusing.

These eyepieces are produced in 8 mm., 16 mm., and 32 mm. effective focal lengths only.



Price postpaid, \$15.95 each

ASTRONOMICAL OBJECTIVES



These objectives are sold with cells and rigidly tested on double stars for resolving power before being sold.

WE CAN SHIP from stock quality astronomical objectives with the following features:

1. Superior optical design utilizing a larger air separation. Color corrected on C and F and hand corrected on spacing to reduce residuals to a minimum. Completely free of coma.
2. Glass-air surfaces magnesium fluoride coated, increasing light transmission approximately 10 per cent.
3. Quality optical glass precision annealed and held to one ring test plate match.
4. Cell made to precision tolerances and suitably coated to prevent stray light reflections. Each cell engraved with effective focal length and serial number.

These objectives are supplied as follows:

3" C.A.	45" E.F.L.	\$ 49.00
4" C.A.	60" E.F.L.	\$119.00

Unconditionally guaranteed — Immediate delivery

CHESTER BRANDON

Box 126, Montrose, California

OBSERVER'S PAGE

Universal time is used unless otherwise noted.

VISUAL OBSERVING PROGRAMS FOR AMATEURS—XXVI

Double Star Observing

Double stars present a pretty picture when they are seen in the telescope. It is said that Alfred Lord Tennyson, the poet laureate of the previous century, was so fond of them that he never wearied of looking at them with his 2-inch refractor. Most of us, as amateurs, use double stars from time to time to check the resolving power of our telescopes, and that is about all the attention we give them, except when we show such fine objects as Albireo, Mizar, and Cor Caroli to visitors.

This is an observing field in which there is no formal program for amateurs in operation at present, but I am told that professional astronomers would be glad if capable amateurs would devote serious attention to double stars. What is needed are current measurements of the angular separations and position angles of hundreds of these objects, earlier observations being listed in Aitken's catalogue.

For double star measurements, a telescope must be equipped with a very steady equatorial mounting and a clock drive, though the drive need not be of the accuracy required for photography. To avoid vibration, the instrument must be sheltered from the wind, and setting circles would be a definite aid in locating the double stars. Telescopes of 6-inch to 12-inch aperture, with excellent definition at high powers, are recommended for this work. A power of 50 per inch of aperture is about the smallest useful magnification.

If the above requirements are met, there is one more big hurdle—that of procuring a filar position micrometer. This is a device whereby crosshairs may be rotated in

the field of view in order that the position angle, the orientation of the pair of stars on the sky, can be determined; the crosshairs are both fixed and movable, to permit setting them for the angular separation of each pair. Obviously, such a device must be carefully built; filar micrometers are therefore expensive. If enough interest is worked up it is my understanding that a saving can be obtained if six or more are ordered at one time; even then the cost of making them in the optical shop of a large observatory would be about 300 or 400 dollars apiece.

It is possible, however, that a local observatory may have equipment available which is not being used, and a diligent amateur might be able to arrange to start or even take over a visual observing program on these stars.

Amateurs with suitable equipment and interest in double star observing, for which there is a real need, and for whom the instrumentation cost is not prohibitive, can easily create for themselves an important observing program. Dr. G. Van Biesbroeck, Yerkes Observatory, Williams Bay, Wis., has volunteered to furnish a suitable list of binary stars to anyone interested, if the size of the telescope to be used is given.

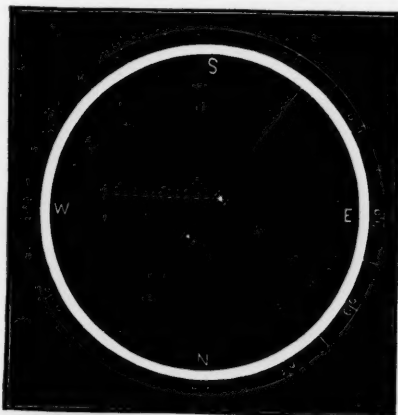
Comet Brightnesses

Searching for comets is one of the most famous of amateur observers' activities. Such men as Leslie C. Peltier, Delphos, Ohio, and Clarence L. Friend, Escondido, Calif., have served astronomy by their patient and efficient scanning of the heavens. But here we shall emphasize another phase of comet study for which there also is no formal program, although the recorder of the AAVSO, Mrs. Margaret W. Mayall, has agreed to act as the receiving agency for any such observations that are sent to her.

As all of us know, comets get brighter as they approach the sun and fainter as they recede. But their brightness increases during approach at a faster rate than would be expected from the inverse square of the distance law alone. Often the brightness varies in an unexpected manner, and occasionally the brightness is irregularly variable. Thus, estimates of a comet's brightness during the time it is visible are of value. Usually, one can follow the object for a few days or weeks (months at the most) until it gets too near the sun in the sky or becomes too faint to be easily visible in the particular telescope being used.

Information concerning bright comets of general interest is usually carried in this department of **Sky and Telescope**, but serious comet observers should subscribe to the Harvard Announcement Cards,* where the predicted positions of comets of all brightnesses are published. The information on the cards will enable

*Order from Harvard College Observatory, Cambridge 38, Mass., enclosing check or money order: \$4.00 for 50 consecutive cards; \$7.50 for 100 consecutive cards.



A double star in the inverted field of view of a position micrometer. The fixed and movable wires (a and m) are set on the component stars to measure their distance apart. The parallel wires indicate position angle, which is here about 320°. The arrow shows the direction in which the star drifts when the driving clock is stopped; therefore this is west. From "Astronomy," by Russell, Dugan, and Stewart.



WAR SURPLUS BARGAIN

PTICS

ACHROMATIC TELESCOPE OBJECTIVES—Perfect Magnesium Fluoride Coated and cemented Gov't. Surplus lenses made of finest Crown and Flint optical glass. They are fully corrected and have tremendous resolving power and can be readily used with 1/4" F.L. eyepieces. Guaranteed well suited for Astronomical Telescopes, Spotting Scopes, etc. Gov't. cost approximately \$100.00.

Diameter	Focal Length	Each
54 mm (2 1/8")	600 mm (23 1/2")	\$12.50
59 mm (2 5/16")	308 mm (12 1/4")	10.00
78 mm (3 1/16")	381 mm (15")	21.00
78 mm (3 1/16")	461 mm (17 3/4")	21.00
81 mm (3 3/16")	622 mm (24 1/2")	22.50
83 mm (3 1/4")	660 mm (26")	28.00
83 mm (3 1/4")	711 mm (28")	28.00
83 mm (3 1/4")	876 mm (34 1/2")	28.00
83 mm (3 1/4")	1016 mm (40")	30.00

*Not coated

SYMMETRICAL EYEPIECE LENS SET

Each set consists of two magnesium-fluoride coated and cemented achromats, and exact Gov't. spacing diagram. Gives wide flat field. 1/2" E.F.L. (20X) Lens Set 13-mm dia. \$4.50

3/4" E.F.L. (13X) Lens Set 18-mm dia. \$3.50

Rectangular Magnifying Lens—Seconds,

sells for \$6.50. Size 2" x 4" \$1.00

First Surface Mirror 12"x15" 1/4" thick \$8.75

First Surface Mirror 8"x10" 1/4" thick 4.25

First Surface Mirror 4"x4" 1/4" thick 1.50

First Surface Mirror 1 1/4"x1 1/2" 1/16" thick .25

Optical Peep Sight—Use as camera viewfinder, etc. Dia. 1 1/2", weight 1 1/2 oz. \$1.00

LENS CLEANING TISSUE—500 sheets 7 1/2" x 11". Bargain priced at only \$1.00

RIGHT ANGLE PRISMS

8-mm face .. ea. \$.75 28-mm face .. ea. \$1.75

12-mm face .. ea. .75 38-mm face .. ea. 2.00

23-mm face .. ea. 1.25 47-mm face .. ea. 3.00

!!!NEW LOW PRICES!!!

BEAUTIFUL IMPORTED BINOCULARS
Precision made, at a low low price within the reach of every man's pocketbook. Complete with carrying case and straps.

8 x 25 Binocular \$23.30*

8 x 30 Binocular 29.50*

7 x 35 Binocular 60.00*

7 x 35 Binocular .. Coated 65.00*

7 x 50 Binocular 33.75*

7 x 50 Binocular .. Coated 39.75*

10 x 50 Binocular 50.00*

10 x 50 Binocular .. Coated 60.00*

16 x 50 Binocular .. Coated 60.00*

*Plus 20% Federal Excise Tax



MOUNTED EYEPIECE has two lenses 29 mm in dia. Cell fits 1 1/4" tube. \$4.50

MOUNTED EYEPIECE has two achromats, 27 mm in dia. Cell fits 1 1/4" tube. 1-7/16" E.F.L. (7X) \$4.00



3x ELBOW TELESCOPE—Makes a nice low-priced finder. 1" Achromatic Objective. A 1/2" Prism Erecting System. 1 1/2" Achromatic Eye and Field Lens. Small, compact, light weight. 2 lbs.

Gov't. Cost \$200.

Plain Optics \$6.50 Coated Optics \$10.50

"MILLIONS" of Lenses, etc.
Free Catalogue

We pay the POSTAGE—C.O.D.'s you pay postage. Satisfaction guaranteed or money refunded if merchandise returned within 10 days.

A. JAEGER 6918 West Merrick Rd.
Lynbrook, N. Y.

initial observations of the comet to be made, and will assist in its recovery by the individual observer in the event it becomes "lost" during a spell of bad weather.

As the comet moves rapidly among the stars, choose for comparison stars those which are near it at the time and are of suitable brightnesses above and below the comet's. Naked-eye stars can be recorded by name, and their magnitudes can be obtained from the Yale **Catalogue of Bright Stars** or similar sources. But if faint stars must be used, a good sketch should

be made, tying in the comparison stars with those shown in a good atlas, such as the AAVSO, Norton's, Skalnate Pleso, Webb's, or the **Bonner Durchmusterung**. As the comet moves, certain comparison stars will have to be abandoned and others introduced in their place.

Observations should be made with low-power binoculars or a very wide-angle low-power telescope, and the image should be thrown considerably out of focus. Instruments of higher power limit the availability of comparison stars, but they may be employed provided the same instrument is used for all the observations of a particular comet. In effect, the out-of-focus method eliminates the light of the tail, enabling one to estimate the brightness of the coma and nucleus alone. It is usually surprising how the brightness of a comet seems to diminish under these conditions. A comet which is quite the most conspicuous object in its part of the sky may, upon examination, turn out to have only a 2nd- or 3rd-magnitude head. The comparison stars also should be examined with the same out-of-focus setting that is used for the comet.

Suppose, for example, that the comet has been brightening and you have used three comparison stars, C, B, and A, during the course of a week, C being the faintest and A the brightest. On the night when the comet seemed to be one quarter of the way up in brightness from C to B, your observation should read: B:3:Comet:1:C. Always list the brightest comparison star first.

On another night, with the comet 60 per cent of the way up from B to A, your observation should read: A:4:Comet:6:B. When the comet was as bright as B, you would record Comet = B.

From such observations, after the magnitudes of the comparison stars have been ascertained, a series of estimates of the comet's actual brightness can be made. But the observations are of no value if you do not submit a tracing or sketch to exact scale showing the comparison stars and the chart on which they are to be found, for instance, AAVSO **Atlas** chart 12. In your report, be sure to give exact dates and times; specify the method of observing used, such as "7 x 50 binoculars, out-of-focus images."

This same general observing method, by the way, should be applied to a nova until one secures a specific chart for it, and to asteroids and planets like Uranus and Neptune.

Nova Search

Interest in hunting for novae increases after each bright new star appears in the sky. In 1935, as a result of the 1934 outburst of Nova Herculis, now called unromantically DQ Herculis, the Milwaukee Astronomical Society and the AAVSO set up a formal program of searching for novae. Owing to the recent dearth of bright novae, this program is now at low ebb, though some of us old-timers still search the whole dome of the sky each clear night, and perhaps one or two chosen areas in the Milky Way. The entire setup was described in an article, "The Search for New Stars," in **Sky and Telescope** for May, 1947, and AAVSO headquarters still has reprints available.

Anyone, however, can start on this program on a clear night. Simply go out under the stars with a flashlight and a good chart and check each bright star you see, say down to the 3rd magnitude, against the stars shown in the chart. If you see an interloper, be sure it is not one of the bright planets; if it is definitely new, then telegraph or telephone your nearest large observatory at once. Take care to identify all stars precisely, and watch out for strange appearances of well-known stars and planets when they are near the horizon.

If you are interested in searching smaller areas with binoculars to, say, about the 6th magnitude, choose a small area or two in the Milky Way (where faint novae are most likely to appear) and go over them thoroughly night after night comparing what you see with the stars in a good atlas.

My experience leads me to believe that I cannot remember all the stars in the sky down to the 3rd magnitude with certainty, but from constantly reviewing the heavens once each clear night for many years it is my hope that I might notice a nova of the 3rd magnitude or brighter if it appeared. Others with better eyesight and better visual memories can doubtless do better.

If you want to participate in a formal nova search program, ask the Recorder, AAVSO, Harvard Observatory, Cambridge 38, Mass., for a supply of monthly nova search report cards. Then you can mail in your observations (though the results are negative) each month.

DAVID W. ROSEBRUGH
66 Maple Ave.
Meriden, Conn.

VARIABLE STAR MAXIMA

May 2, Z Ursae Majoris, 6.6, 115158; 2, X Ophiuchi, 6.9, 183308; 9, RS Scorpii, 5.9, 164844; 10, R Horologii, 6.0, 125050; 14, U Ceti, 7.5, 022813; 26, R Normae, 7.2, 152849; 28, R Andromedae, 7.0, 001838. June 1, S Virginis, 7.1, 132706; 3, R Serpentis, 6.8, 154615; 3, T Ceti, 5.5, 001620.

These predictions of variable star maxima are by the AAVSO. Only stars are included whose mean maximum magnitudes are brighter than magnitude 8.0. Some, but not all of them, are nearly as bright as maximum two or three weeks before and after the dates for maximum. The data given include, in order, the day of the month near which the maximum should occur, the star name, the predicted magnitude, and the star designation number, which gives the rough right ascension (first four figures) and declination (bold face if southern).

MOON PHASES AND DISTANCE

First quarter	May 2, 3:58
Full moon	May 9, 20:16
Last quarter	May 16, 14:39
New moon	May 23, 19:28
First quarter	May 31, 21:46
Full moon	June 8, 5:07

	May	Distance	Diameter
Apogee 1, 14 ^h	251,000 mi.	29' 34"	
Perigee 13, 16 ^h	228,400 mi.	32' 31"	
Apogee 29, 8 ^h	251,500 mi.	29' 31"	

	June	Distance	Diameter
Perigee 10, 7 ^h	225,200 mi.	32' 58"	

BROWER SOLAR FILTER

Ideal for direct viewing of the sun with all telescopes. Fits a standard 1 1/4" tube and is placed in front of your eyepiece. It is readily removed (like an eyepiece) for conversion to night viewing. This filter has been developed especially for reflectors and tested thoroughly with all sizes of objectives. It will not crack, or harm the eyepiece or mirror. \$15.00 postpaid

Made only by
LABORATORY OPTICAL CO.
Plainfield, N. J.

EVERYTHING FOR THE AMATEUR

TELESCOPE MAKER

KITS ... \$4.50 up; Pyrex, 6" ... \$7.50 up
Other sizes in proportion.

ALUMINIZING

Superior Reflecting Surface, Fine Finish.
Will not Peel or Blister. Low Prices.

Mirrors	Prisms	Send for
Tested	Eyepieces	Free
Free	Accessories	Catalog

MONEY BACK GUARANTEE

Precision Optical Supply Co.

1001 E. 163rd St., New York 59, N. Y.

DOUBLES 'SCOPE PERFORMANCE!

Sharper images at higher powers! A startling statement positively proven in 16-page telescopic educational matter sent free on receipt of self-addressed long envelope bearing three 3c stamps return postage.

First, the Goodwin Resolving Power lens placed in front of eyepiece gives three times the magnification on each by lengthening your primary focal length angle up to three times, yet extends eyepiece out no more than two inches from normal. This alone sharpens definitions.

Next, by achieving your highest powers on more comfortable low-power eyepieces, you lessen image deteriorations due to short-focus acute bending of the convergent beam, since all usual eyepieces are f/1 or less.

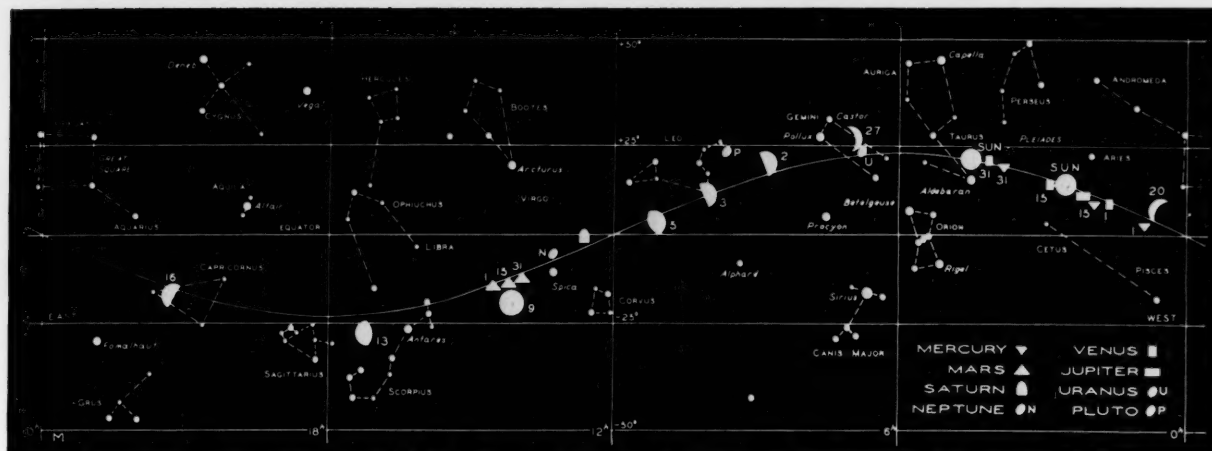
Third, you get greater illumination and wider field by relieving tiny aperture restrictions of higher-power eyepieces.

The Resolving Power lens is achromatic, coated, gives flat field sharp to the edge. Here is astonishment in image improvements! Price \$17.50 in 4" long chrome-plated adapter tube fitting standard 1 1/4" eyepiece holders. Money back if not delighted beyond words after two weeks trial!

No COD's—Colleges and Observatories may send purchase order.

FRANK GOODWIN

345 Belden Ave., Chicago 14, Ill.



THE SUN, MOON, AND PLANETS THIS MONTH

The sun, on the ecliptic, is shown for the beginning and end of the month. The moon's symbols give its phase roughly, with the date marked alongside. Each planet is located for the middle of the month and for other dates shown.

Mercury attains greatest elongation on May 3rd, 26° 45' west of the sun. This is a poor apparition, however, as the planet rises only three quarters of an hour or less before sunrise. For Southern Hemisphere observers, this time will be more than doubled, for Mercury is well south of the sun in the sky.

Venus will be in proximity to the sun in the morning sky, hence not visible.

Mars is spectacular this month, at opposition on May 1st at 1^h UT. On the

8th of May, the ruddy planet will be nearest the earth, 51,860,000 miles away, when it will be of magnitude -1.5, rivaling Sirius. Its telescopic disk, 16".8 in diameter, is a fine object for a telescope of moderate power. Mars this month retrogrades into Virgo, and is visible all night.

Jupiter reappears in the morning sky in late May, rising 1½ hours before the sun on the 31st. Two interesting conjunctions take place, but may be viewed only under favorable conditions with optical aid. On

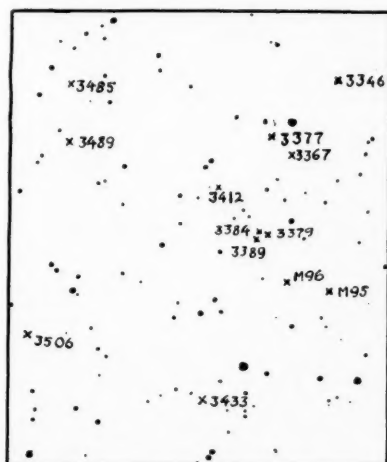
the 5th, Jupiter will be in conjunction with Venus, the latter 19' south, both rising about half an hour before the sun. On the 17th, Mercury will be 1° 45' south of Jupiter.

Saturn sets about dawn, and is in retrograde motion in Virgo. It is a bright object of magnitude +0.8, its rings inclined 6°.8 on the 15th of May. Configurations of its satellites for May were published in the April issue.

Uranus is low in the west for several hours after sunset, about 3° southeast of Epsilon Geminorum.

Neptune is favorably placed in Virgo, as shown by the chart of its path on page 101, February issue.

E. O.



The scale of this chart is one centimeter to one degree. North is at the top, east at the left.

DEEP-SKY WONDERS

THE SIX OBJECTS we discuss this month (plotted centrally on the finder chart) have been seldom mentioned in these pages, although two are bright. M95 is a splendid barred spiral; the classic Lick publication on nebulae calls this "a beautiful object," but the amateur will see only the nucleus. Nearly a degree eastward is M96, "a fine strong spiral." Both of these were discovered by Méchain in 1781, and, lying so close together, they make excellent targets for small instruments. About a degree north following M96 lies a tight little triangle of galaxies with an outlier which will enable the amateur who has located the Messier objects to subject his telescope to further test of its space-sounding powers.

Smyth saw NGC 3379 and 3384, but his 5-inch refractor was unable to reach 3389. Webb follows his description. The third galaxy can be seen, however; the author has fished it up with a 6-inch aperture, and a 10-inch will almost always catch the

somewhat elusive object. It is useless to try without averted vision, and the faintest trace of moonlight, aurora, or cirrus generally will spell failure. Other objects lie scattered about, as the chart and table indicate.

So here, within a small region, are test objects ranging from an extremely easy Messier through an object that baffled as keen an observer as Admiral Smyth. As always, I will be more than glad to get a postcard reporting the experiences of any amateur with this field.

WALTER SCOTT HOUSTON

1040 Madison
St. Charles, Mo.

UNIVERSAL TIME (UT)

TIMES used on the Observer's Page are Greenwich civil or Universal time, unless otherwise noted. This is 24-hour time, from midnight to midnight; times greater than 12:00 are p.m. Subtract the following hours to convert to standard times in the United States: EST, 5; CST, 6; MST, 7; PST, 8. If necessary, add 24 hours to the UT before subtracting, and the result is your standard time on the day preceding the Greenwich date shown. Add one hour for daylight-saving time.

NGC	Herschel Mag.	Dimensions	Type
3346	7 ⁵	12.4	2.5 x 2.0
3351	(M95)	11.5	3.0 x 3.0
3367	7 ⁸²	12.3	2.0 x 2.0
3368	(M96)	10.4	7.0 x 4.0
3377	9 ⁹²	11.6	1.5 x 0.8
3379	17 ¹	10.8	2.0 x 2.0
3384	18 ¹	11.3	3.0

R. A.	Dec.	NGC	Herschel Mag.	Dimensions	Type
10 41.0	+15 09	3389	41 ²	12.6	2.0 x 0.9
10 41.3	11 58	3412	27 ¹	11.6	2.5 x 1.3
10 44.0	14 01	3433	20 ³	12.9	2.0 x 2.0
10 44.2	12 05	3485	100 ²	12.8	1.3 x 1.2
10 45.1	14 15	3489	101 ²	11.3	2.5 x 1.0
10 45.2	12 51	3506	22 ³	13.2	...
10 45.7	+12 54				

R. A.	Dec.
10 45.8	+12 48
10 48.3	13 41
10 49.4	10 26
10 57.4	15 06
10 57.7	14 10
11 00.6	+11 21

Data in the table, like previously published information on galaxies, is from the Shapley-Ames catalogue, "A Survey

of the External Galaxies Brighter than the Thirteenth Magnitude," Harvard **Annals** 88, No. 2. The magnitudes are photo-

graphic, and half a magnitude brighter will more closely approximate the visual appearance of the objects.

THEODOLITES

Made by David White — used by weather stations to track balloons. Condition from very good to fair. Limited quantity. Price from \$125.00.

A. COTTONE & CO.

340 Canal St. New York 13, N. Y.

Institutions — write on your letterhead for our latest bulletin.



YOU SHOULD OWN A MICRO CIRCLE CUTTER

A well-built tool for those odd size holes. Cuts through $\frac{1}{2}$ inch of steel. Has MICRO-MATIC SIZE ADJUSTOR. Comes complete with tool steel cutting bit for extra long service.

Specify round (7/16") or square shank. See your local distributor or write us.

PRECISE MEASUREMENTS COMPANY
942 Kings Highway, Brooklyn 23, N. Y.

WE REPAIR

★ Microscopes ★ Telescopes
★ Field Glasses ★ Binoculars

WE BUY, SELL, EXCHANGE
OPTICAL AND SCIENTIFIC
INSTRUMENTS

WAELDIN

10 Maiden Lane
New York City
BEekman 3-5393

SKY-GAZERS EXCHANGE

Classified advertising costs 10 cents a word, including address; minimum charge \$2.50 per ad. Remittance must accompany order. Insertion is guaranteed only on copy received by the first of the month preceding month of issue; otherwise, insertion will be made in next available issue. We cannot acknowledge classified ad orders. Write Ad Dept., Sky and Telescope, Harvard Observatory, Cambridge 38, Mass.

FOR SALE: Mounted 5" and 6" refractor objectives of first quality, \$200.00 and \$300.00. Edged 4" blanks, \$22.50. Correspondence invited. Earl Witherspoon, Sumter, S. C.

TELESCOPE MAKERS in the New York metropolitan area, interested in facilities for making mirrors and optical equipment, are invited to communicate with William P. Hughes, 647 East 15th St., Brooklyn 30, N. Y.

FOR SALE: New but slightly scratched 10" pyrex mirrors f/5 and f/8; aluminized. \$75.00 each. Return privilege. C.O.D.'s filled. Astronomical Laboratories, 71-12 35 Ave., Jackson Heights, N. Y.

FOR SALE: 4" Bardou refractor, special \$489.00. 4" Alvan Clark refractor. Spotting scopes, microscopes, binoculars. Books on astronomy and microscopy. Rasmussen and Reece, Amsterdam, N.Y.

NORTON'S "Star Atlas and Reference Handbook," latest edition 1950, \$5.25. "Atlas Celeste," \$2.55. "Bonner Durchmusterung," southern part, \$38.50. Moon maps, other foreign, and all domestic publications. Herbert A. Luft, 42-10 82nd St., Elmhurst 73, N. Y.

WANTED: Amateur equipment, in particular: accurately figured 10" parabolic mirror; slightly larger flat; metal parts of binocular. Richardson, 5284-W. 35th Ave., Vancouver, Canada.

FOR SALE: Complete run of "The Telescope," "Sky," and first two volumes of "Sky and Telescope." Good condition. \$45.00. Catalogue of astronomical books sent upon request. C. Benevento, 83 Hoyt St., Brooklyn 2, N. Y.

FOR SALE: College professor going abroad wishes to sell 6" reflector telescope, excellent condition, sacrifice, \$55.00. Dr. J. Anthony Dietrich, 1970 University, New York 53, N. Y.

OCCULTATIONS OF STARS IN THE BEEHIVE

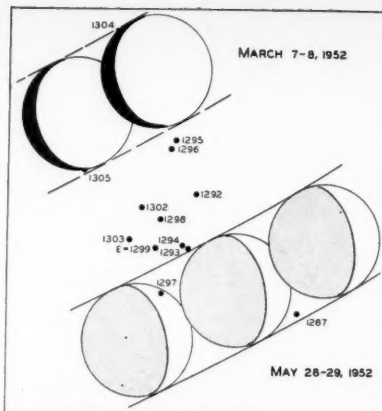
EXCELLENT CONDITIONS of visibility will prevail on the Atlantic seaboard (weather permitting) when the moon passes in front of Praesepe, the Beehive cluster in Cancer. Immersions of the stars occur at the dark limb of a crescent moon at favorable altitudes. Limitations for stations farther west will be imposed only by twilight.

The diagram is of the principal stars in the Beehive. In the lower part are shown successive positions of the moon on the night of May 28-29, at 1^h, 2^h, and 3^h, Universal time, as seen at Rochester. Subtract five hours from these times for Eastern standard time, and six hours for Central standard; thus, the first position is for 8 o'clock in the evening along most of the Atlantic Coast.

Stars 1287 and 1297 will be occulted at Station A, while at Station C (Washington, D. C.) the moon will miss 1287 but will occult 1293. On a southeasterly line somewhere between Rochester and Washington, 1287 will undergo grazing contact. On a parallel line, the same will happen to 1293, but computations have not been made to show the accurate location of these lines. It is evident from the diagram that through a very thin zone, something like that of the path of totality in a solar eclipse, both stars will disappear.

Furthermore, a little south of Washington, star 1294 will also be hidden, while in the southeast it is likely that 1299 will be occulted. It would be interesting to hear from observers along these lines of grazing contacts; the possibilities of seeing a star momentarily emerge in a valley along the moon's edge should not be overlooked.

The upper part of the diagram shows the path taken by the moon on March 7-8, when two other stars were occulted. It was our regular meeting night here in Rochester, but there was a complete overcast. The separation of the moon's two paths results from the regression of the descending node and the difference in the



The star numbers are from the "American Ephemeris." No. 1299 is Epsilon Cancri. Diagram by Paul W. Stevens.

hour angle of the moon at the two periods of observation. In this case the two factors are additive. Next fall, when the conjunction of the moon with Praesepe takes place east of the meridian, to be observed in the early morning hours, the effect of hour angle will act in the opposite direction just as was the case with Regulus in 1951.

The stars listed here are all plotted on the accompanying chart, and data on their occultations is from the American Ephemeris, and the British Nautical Almanac. The occultations are all immersions or disappearances. For each star is given the standard station designation, the Universal time, *a* and *b* quantities in minutes, and the position angle on the moon's limb.

1287 A 1:18.2 +0.6 -3.0 172; B 1:10.0 +0.4 -2.8 167.
1293 C 2:09.8 ... 50.
1294 F 1:54.2 -1.2 -1.6 108.
1297 A 2:15.7 -0.5 -1.3 79; B 2:11.4 -0.6 -1.3 75; C 2:18.4 -0.5 -1.4 91; D 2:10.3 -0.6 -1.4 86; E 2:08.3 -0.7 -1.8 108; F 2:21.9 -0.4 -2.2 135.
1298 F 2:15.5 ... 61.
1299 E 2:20.3 ... 49; F 2:13.6 -1.4 -1.2 93.
1303 F 2:37.6 -2.2 0.0 63.

The *a* and *b* quantities tabulated in each case are variations of standard-station predicted times per degree of longitude and of latitude, respectively, enabling computation of fairly accurate times for one's local station (long. *Lo*, lat. *L*) within 200 or 300 miles of a standard station (long. *LoS*, lat. *LS*). Multiply *a* by the difference in longitude (*Lo - LoS*), and multiply *b* by the difference in latitude (*L - LS*), with due regard to arithmetic signs, and add both results to (or subtract from, as the case may be) the standard-station predicted time to obtain time at the local station. Then convert the Universal time to your standard time.

Longitudes and latitudes of standard stations are:

A +72°.5, +42°.5	E +91°.0, +40°.0
B +73°.6, +45°.6	F +98°.0, +31°.0
C +77°.1, +38°.9	G +114°.0, +50°.9
D +79°.4, +43°.7	H +120°.0, +36°.0
I +123°.1, +49°.5	

PAUL W. STEVENS
2322 Westfall Rd.
Rochester 18, N. Y.

MINIMA OF ALGOL

May 2, 10:25; 5, 7:14; 8, 4:03; 11, 0:52; 13, 21:41; 16, 18:30; 19, 15:19; 22, 12:08; 25, 8:57; 28, 5:45; 31, 2:34. June 2, 23:23; 5, 20:12.

These predictions are geocentric (corrected for the equation of light), based on observations made in 1947. See *Sky and Telescope*, Vol. VII, page 260, August, 1948, for further explanation.



The Beehive cluster in Cancer, photographed by George and Jerry Andrus.

HERE AND THERE WITH AMATEURS

*Members receive Sky and Telescope as a privilege of membership. †Member organizations of the Astronomical League.

State	City	Organization	Time	Meeting Place	Communicate With
ALABAMA	Gadsden	Ala. A.A.	7:30, 1st Thu.	Ala. Power Audit.	Brent L. Harrell, 1176W or 55
ARIZONA	Phoenix	*Phoenix Obs. Ass'n.	8:00, 1st, 3rd Tue.	Phoenix College	Paul E. Griffin, 1708 S. 3rd St.
CALIFORNIA	Kentfield	*Marin Am. Ast.	8:00, 4th Fri.	Marin College	Mrs. I. Osborn, 223 Santa Margarita, San Rafael
	Los Angeles	L.A.A.S.	7:45, 2nd Tue.	Griffith Obs.	H. L. Freeman, 853 1/2 W. 57 St.
	Norwalk	*Excelsior Tel. Club	7:00, Thu.	Excelsior Union H.S.	Geo. F. Joyner, 12008 E. Sproul St.
	Oakland	*Eastbay A.S.	8:00, 1st Sat.	Chabot Obs.	Miss A. Roemer, 1556 Everett, Alameda
	Palo Alto	*Peninsula A.S.	7:30, 1st Fri.	Community Center	H. W. Milner, 350 Tennyson Ave.
	Sacramento	*Sac. Val. A.S.	8:00, 1st Tue., bi-mon.	Sacramento College	Mrs. E. Champ, 3816 Sacramento Blvd. (17)
	San Diego	Ast. Soc. of S.D.	7:30, 1st Fri.	504 Electric Bldg.	W. T. Skilling, 3140 Sixth Ave.
	San Diego	A.T.M. Ast. Club	7:30, 2nd, 4th Mon.	3121 Hawthorn St.	G. A. Sharpe, 4477 Muir, Bayview 3757
	Stockton	*Stockton A.S.	8:00, 2nd Mon.	Stockton College, P-11	C. D. Corwin, 1427 N. Center St. (3)
COLORADO	Denver	†Denver A.S.	8:00, 2nd, 4th Mon.	Chamberlin Obs.	W. E. Johnson, 264 S. Gilpin St. (9)
CONNECTICUT	Middletown	*Centr. Conn. A.A.	8:00, 1st Tue.	Van Vleck Obs.	Walter Fellows, Middle Haddam
	New Haven	†A.S. of New Haven	8:00, 4th Sat.	320 York St.	Mrs. Helen Velardi, 437 Wash., N'th Haver
	Stamford	Stam. Museum A.A.	8:00, 3rd Fri.	Stamford Museum	R. F. Ives, Post Rd. East, Darien
DIST. COL.	Washington	†Nat'l. Cap. Ast'mers	8:00, 1st Sat.	Comm. Dept. Audit.	Mrs. G. R. Wright, 202 Piping Rk. Dr., Silv. Spr., Md.
FLORIDA	Daytona Beach	D. B. Stargazers	8:00, 1st Mon.	105 N. Halifax Ave.	Wm. T. Thomas, 105 N. Halifax
	Jacksonville	†J.A.A.C.	8:00, 1st, 3rd Mon.	Private homes	E. L. Rowland, Jr., 442 St. James Bldg.
	Key West	†Key West A.C.	8:00, 1st Wed.	Private homes	W. M. Whitley, 1307 Div. St., 724-R
	Miami	†South'n Cross A.S.	7:30, Every Fri.	M. B. Lib. Grounds	A. P. Smith, Jr., 426 S.W. 26 Rd.
	Miami Springs	†Gulfstream A.A.	8:00, 4th Fri.	Armory, U. of Miami	L. G. Pardue, 641 Falcon, 88-5434
GEORGIA	Atlanta	†Atlanta A.C.	7:30, 2nd Fri.	Agnes Scott College	W. H. Close, 225 Forkner Dr., Decatur
ILLINOIS	Chicago	*Burnham A.S.	4:00, 2nd Sun.	Adler Planetarium	Wm. Callum, 1435 Winona St.
	Geneva	*Fox Valley A.S.	8:00, 1st Tue.	Geneva City Hall	Joseph Zoda, 501 S. 6th St., St. Charles
	Moline	†Popular A.C.	7:30, Wed.	Sky Ridge Obs.	Carl H. Gamble, 3201 Coalton Rd.
INDIANA	Indianapolis	†Indiana A.S.	2:15, 1st Sun.	Riley Library	Clark B. Hicks, 305 Ruckle St.
	South Bend	St. Jos. Valley Ast.	8:00, 1st on.	Hotel La Salle	Miss I. DeBruycker, 1023 S. Union, Mishawaka
KANSAS	Topeka	*Topeka A.A.S.	7:30, 2nd Mon.	Topeka H.S.	Miss N. Utschen, 1607 Wayne Ave.
	Wichita	†Wichita A.S.	8:00, 1st Wed.	21 East High Sch.	S. S. Whitehead, 2322 E. Douglas, 62-6642
KENTUCKY	Louisville	†L'ville A.S.	8:00, 1st Tue.	Univ. of Louisville	B. F. Kubaugh, 621 34th St.
LOUISIANA	New Orleans	A.S. of N.O.	8:00, Last Wed.	Cunningham Obs.	Dr. J. Adair Lyon, 1210 Broadway
MAINE	Portland	†A.S. of Maine	8:00, 2nd Fri.	Private homes	H. Harris, 27 Victory Ave., S. Portland
MASSACHUSETTS	Cambridge	†Bond A.C.	8:15, 1st Thu.	Harvard Obs.	Dr. Dorrit Hoffleit, Harvard Observatory
	Cambridge	†A.T.M.s of Boston	8:00, 2nd Thu.	Harvard Obs.	H. Smith, 26 Kingman St., Weymouth, 9-3438-R
	Springfield	†S'field Stars	8:00, 2nd Wed.	Private homes	F. D. Korkosz, Mus. Nat. Hist., 2-4317
	Worcester	†Aldrich A.S.	7:30, 1st, 3rd Tue.	Mus. Natural Hist.	W. C. Lovell, 24 Courtland (2), 3-1559
MICHIGAN	Ann Arbor	†Ann Arbor A.A.A.	7:30, 2nd Mon.	U. of Mich. Obs.	Stewart W. Taylor, 1106 Birk Ave.
	Battle Creek	†B. C. Ast. Club	8:00, 2nd Fri.	Kingman Museum	Mrs. W. V. Eichenlaub, 47 Everett St.
	Detroit	†Detroit A.S.	8:00, 2nd Sun.	Wayne U., State Hall	E. R. Phelps, Wayne University
	Kalamazoo	†Kalamazoo A.A.A.	8:00, Sat.	Private homes	Mrs. G. Negrevski, 2218 Amherst, 31482
	Lansing	†Lansing A.A.	8:00, 1st, 3rd Wed.	Technical H. S.	Mrs. T. A. Loudon, 940 Bench St. (14)
	Pontiac	†Pon.-N.W. Det. A.A.	8:00, 3rd Sun.	Cranbrook Inst.	G. Carhart, 40 Hadsell Dr., FE 2-9980
MINNESOTA	Duluth	*Darling A.C.	8:00, 1st, 3rd Fri.	Darling Obs.	Mrs. A. Lynch, 1911 Wisconsin, Superior, Wis.
	Minneapolis	M'polis A.C.	7:30, 1st, 3rd Wed.	Public Library	Jane Simmer, 2406 Clinton Ave. S.
	St. Paul	*St. Paul Tel. Club	7:30, 2nd, 4th Wed.	Macalester Coll.	Mrs. H. Wolcott, 1705 Scheffer Ave. (5)
MISSOURI	Fayette	†Central Mo. A.A.	7:30, Last Sat.	Morrison Obs.	R. C. Maag, 807 W. 7th, Sedalia
	Kansas City	†A.A. & T.M.s	8:00, 4th Sat.	Private homes	Reginald Miller, Merriam, Kans.
	St. Louis	†St. Louis A.A.S.	8:00, 3rd or 4th Fri.	Inst. of Tech., St. L. U.	S. O'Byrne, 501 E. Pacific, Webster Groves 19
NEVADA	Reno	A.S. of Nev.	8:00, 4th Wed.	Univ. of Nevada	E. W. Harris, University of Nevada
NEW JERSEY	Caldwell	West Essex A.A.	8:00, 2nd Mon.	Caldwell Mun. Bldg.	D. C. Smith, 19 Francisco Ave., W. Caldwell
	Jersey City	†Revere Boys Club	7:15, Mon., Tue.	Gregory Mem. Obs.	Enos F. Jones, 339 Wayne St.
	Roselle Park	†A.A.S. of Union Co.	..... 4th Fri.	Boro Hall	Mrs. R. N. Bochau, 236 Normandy Vill., Union
	Teaneck	†Bergen Co. A.S.	8:30, 2nd Wed.	Obs., 107 Cranford Pl.	J. M. Stefan, 332 Herriek
NEW MEXICO	Las Cruces	*A.S. of L.C.	..... 1st Sat.	Private homes	C. W. Tombaugh, 636 S. Alameda
NEW YORK	Buffalo	†A.T.M.s & Observers	7:30, 1st Wed.	Mus. of Science	Dr. F. S. Jones, 83 Briarcliffe, Cheektowaga (25)
	Gloversville	†A.C. of Fulton Co.	8:00, 1st Wed.	.....	L. R. Ogden, 60 W. Pine St.
	New York	*A.A.A.	8:00, 1st Wed.	Amer. Mus. Nat. Hist.	G. V. Plachy, Hayden Plan., TR 3-1300
	New York	†Junior A.C.	7:30, 4th Fri.	Amer. Mus. Nat. Hist.	J. Rothschild, Hayden Plan., TR 3-1300
	Rochester	†Rochester A.C.	8:00, Alt. Fri.	Rochester Museum	H. O. Woodard, 485 Hayward Ave. (9)
	Schenectady	†S'tady A.C.	7:30, 2nd Mon.	Nott Terrace H.S.	C. E. Johnson, 102 State St.
	Troy	*Renss. Ast. Soc.	7:30, Alt. Tue.	Sage Lab., R.P.I.	Dr. Robert Fleischer, R.P.I.
	Utica	†Utica A.A.S.	7:30, 4th Tue.	Proctor Inst.	John Zimm, 239 Thieme Pl.
	Wantagh	Long Island A.S.	8:00, Sat.	Private homes	A. R. Luechinger, Seafood Ave., 1571
N. CAROLINA	Greensboro	†Greensboro A.C.	8:00, 1st Thu.	Woman's Coll., U.N.C.	Mrs. Z. V. Conyers, 210 W. Fisher Ave.
	Raleigh	†Astronomical Soc.	..... 1st, 3rd Thu.	R. C. State Coll.	Richard C. Davis, Sch. of Textiles
	Winston-Salem	†Forsyth A.S.	7:30, Last Fri.	Private homes	Kenneth Shepherd, 1339 W. 4th St.
OHIO	Akron	*A.C. of Akron	8:00, 2nd Fri.	Beth.-Luth. Church	Mrs. R. J. Coutts, 878 Kennebec Ave. (5)
	Cincinnati	*Cin. A.A.	8:00, Various days	Cincinnati Obs.	Robert Berkmeier, 2432 Ohio Ave.
	Cincinnati	*Cin. A.S.	8:00, 3rd Wed.	5556 Raceview Ave.	John Dann, 3315 Pellicy Dr. (11)
	Cleveland	†Cleveland A.S.	8:00, Fri.	Warner & Swasey Obs.	Mrs. A. Townhill, Warner & Swasey Obs.
	Columbus	*Columbus A.S.	7:30, 3rd Sat.	McMillin Obs.	J. A. Hynek, Ohio State Univ.
	Dayton	A.T.M.s of Dayton	Even., 3rd Sat.	Private homes	F. E. Sutter, RR 7, Box 253A (9)
	Lorain-Elyria	*Black River A.S.	7:30, 2nd Tue.	Lorain YMCA	Louis Rick, Box 231, Lorain
	Marietta	Marietta A.S.	Irregular	Cisler Terrace	Miss L. E. Cisler, Cisler Terrace
	Toledo	Toledo Ast. Club	..... 3rd Tue.	Univ. of Toledo Obs.	E. D. Edenburn, 4124 Commonwealth Ave.
	Warren	Mahoning Val. A.S.	8:00, Thu.	Private homes	S. A. Hoynos, 1574 Sheridan, NE, 25034
	Youngstown	*Y'town A.C.	7:30, 1st Fri.	Homestead Pk. Pav'n.	F. W. Hartenstein, 905 Brentwood
OKLAHOMA	Tulsa	†Tulsa A.S.	7:30, 1st Sat.	Private homes	Roy N. O'Mara, 1112 N. Braden
OREGON	Portland	†Portland A.S.	8:00, 1st Mon.	Planetarium	H. J. Carruthers, 427 S. E. 61 Ave.
	Portland	†A.T.M. & Observers	8:00, 2nd Tue.	Mus. of Sci. and Ind.	N. C. Smale, 831 N. Watts St.
PENNSYLVANIA	Beaver	†Beaver Co. A.A.A.	8:00, 4th Tue.	Com'y Bldg., Tamaqui	Mrs. R. T. Lucic, Box 463, Baden
	Millvale	A.A.A. Shaler T'ship	8:00, 3rd Fri.	Cherry City Fire House	Cliff Raible, Rebecca Sq. (9)
	Philadelphia	†A.A. of F.I.	8:00, 3rd Fri.	Franklin Institute	Edwin F. Bailey, RIT 3050
	Philadelphia	†Rittenhouse A.S.	8:00, 2nd Fri.	Morgan Physics, U. Pa.	Sarah Lippincott, Sproul Obs., Swarthmore
	Pittsburgh	†A.A.A. of P'burgh	8:00, 2nd Fri.	Buhl Planetarium	G. Winterhalter, 5-J Terrace, McKees Rocks
RHODE ISLAND	Providence	Skyscrapers, Inc.	8:00, Mon. or Wed.	Ladd Observatory	Ladd Obs., Brown U., Jackson 1-5680
S. CAROLINA	Columbia	North'n Cross A.S.	8:15, Every Mon.	Melton Observatory	Dr. L. V. Robinson, Univ. of S. C.
TENNESSEE	Chattanooga	†Barnard A.S.	8:00, 3rd Fri.	Jones Observatory	C. T. Jones, 1102 James Bldg., 7-1936
	Nashville	*Barnard A.S.	7:30, 2nd Thu.	Vanderbilt Univ.	Miss J. Saffer, 446 Humphrey St. (10)
TEXAS	Dallas	†Texas A.S.	8:00, 4th Mon.	Various auditoriums	E. M. Brewer, 5218 Morningside, U6-3894
	Ft. Worth	†Ft. Worth A.S.	8:00, 4th Fri.	Texas Christian U.	L. C. Eastland, 5501 Byers Ave. (7)
	Houston	Houston A.S.	7:30, Last Fri.	Mus. Nat. Hist. Annex	Mrs. J. Murray, 1007 W. Gray (6)
	Port Arthur	†Port Arthur A.C.	..... 2nd Tue.	Private homes	G. van den Berg, Box 266, Groves
	Salt Lake City	*A.S. of Utah	8:00, 2nd Fri.	City and County Bldg.	Junius J. Hayes, 1148 East 1 S.
UTAH	Springfield	†Springfield T.M.s	6:00, 1st Sat.	Stellafane	John W. Lovely, 27 Pearl St., 535-W
VERMONT	Norfolk	†Norfolk A.S.	8:00, 2nd, 4th Thu.	Museum of Arts	A. Husted, U.S. Weather Bureau, 21745
VIRGINIA	Richmond	†Richmond A.S.	8:00, 1st Tue.	Builders Exchange	Miss L. Stevens, 4018 Clinton Ave. (27)
WASHINGTON	Spokane	†A.T.M.s of Spokane	8:00, Last Fri.	Private homes	Chet Brown, W. 1117-14th
	Tacoma	A.A.A.	8:00, 1st Mon.	Coll. of Puget Sd.	Dorothy E. Nicholson, 2816 N. Union Ave.
	Yakima	†Yak. Am. Ast'mers	8:00, 2nd Mon.	Cha. of Comm. Bldg.	Edward J. Newman, 324 W. Yakima Ave.
WISCONSIN	Beloit	Beloit Ast.	..... 1st, 3rd Thu.	YMCA Bldg.	Kenneth W. Schultz, 959 Johnson St.
	Madison	†Madison A.S.	8:00, 2nd Wed.	Washburn Obs.	Dr. C. M. Huffer, Washburn Obs.
	Milwaukee	†Milw. A.S.	8:00, 2nd Mon.	Public Museum	E. A. Halbach, 2971 S. 52 St., W. Allis



The sky as seen from latitudes 20° to 40° south, at 9 p.m. and 8 p.m., local time, on the 7th and 23rd of August, respectively.

SOUTHERN STARS

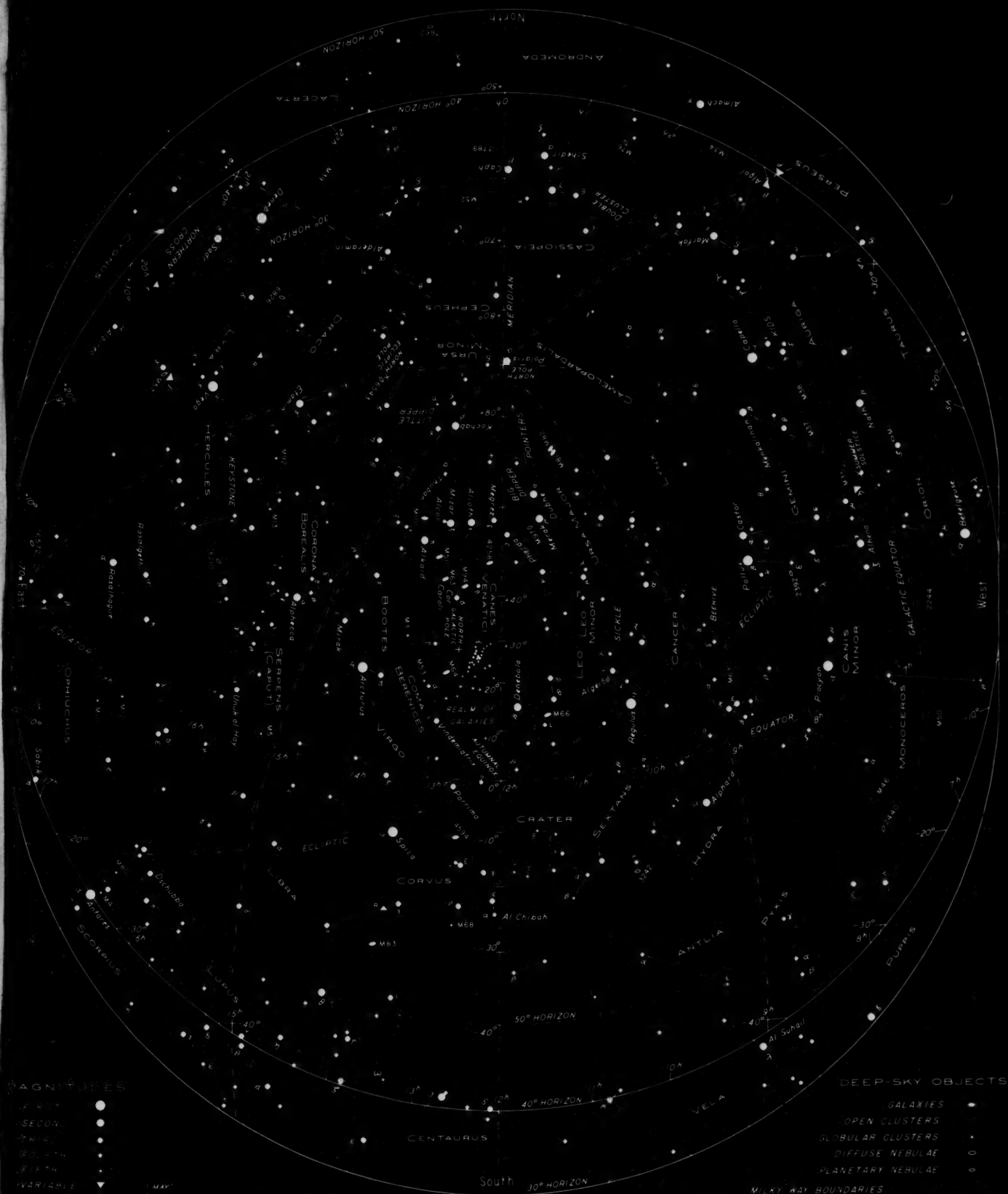
FOUR YEARS after the first portion of the Messier catalogue was published in 1771, a comparable list for the southern skies was printed in the same periodical by the French astronomer Lacaille. Compiled at the Cape of Good Hope, the catalogue included 42 objects, five of which had already been listed by Messier. As Messier extended his list in the *Connais-*

sance des Temps, he included three more of Lacaille's objects; the complete Lacaille catalogue was reprinted each time, however.

Instead of numbering consecutively, Lacaille divided the objects into three classes, designated by Roman numbers. Of the first group, "nebulae without stars," Lac I 11, I 12, and I 13 are near the 18-hour meridian. The first two are globular clusters, M69 and M22, while the

third, NGC 6242, is a galactic cluster of 8th- to 11th-magnitude stars, none of which was resolved by his small telescope.

A representative of group two, "nebulous stars in a cluster," is Lac II 14, M7, described as a collection of 15 to 20 stars. Also in the Scorpius-Sagittarius region are Lac III 12 and Lac III 13, again Messier clusters, M6 and M8. This third group contains "stars accompanied by nebosity." O. G.



STARS FOR MAY

The sky as seen from latitudes 30° to 50° north, at 9 p.m. and 8 p.m., local time,

on the 7th and 23rd of May, respectively; also, at 7 p.m. and 6 p.m. on June 7th and 23rd. For other times, add or subtract ½ hour per week. When facing north, hold

"North" at the bottom; turn the chart correspondingly for other directions. The projection (stereographic) shows celestial co-ordinates as circles.



